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Effects of the Correction of Color Perception Disturbances on Migraine-Results of a Pilot Study

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Abstract | **Original Research Article**

Aim: Migraine is a wide-spread disease from which many men and women suffer, and visual deficits are one of several reasons for headaches. The effectiveness of spectacles has been documented not only for headaches, but in many other kinds of illnesses. According to the current literature, the correction of disturbances of the color vision with colored glasses appear to be effective e.g. for dyslexia, psychosomatic diseases, or epilepsy. This aspect has been taken up in the present study for migraine attacks. ***Methods:*** A total of 27 subjects were divided into an experimental and a control group. They were asked to wear either colored (experimental group) or slightly mirrored glasses (controls). Colored glasses were selected according to the personal preference of the patient. In migraine diaries the patients recorded the weekly number of migraine attacks with these glasses, which have to be worn for at least three hours a day and without glasses as well. ***Results:*** There was a significant improvement for the experimental group after the eight-week study period (from 1.6 to 1.03 migraine attacks per week, but the control group experienced also a reduction of weekly migraine attacks (from 1.29 to 0.89 attacks per week). In addition, both groups showed an improvement in color perception in the Ishihara-test (17.8 to 20.0 correct detected numbers in the experimental and 18.0 to 19.6 in the control group). A possible explanation for the small differences between the experimental and the control group is that the mirroring glasses, which were used as placebo-condition, even increased the contrast of the vision and therefore could have had a real positive effect, too. They darkened the vision and many migraine-patients complained about being disturbed by bright light. Therefore, wearing this kind of sun-glasses in activities of daily living even may have reduced the visual stress. ***Conclusion:*** In migraine-patients with deficiencies of color recognition both kind of lenses proved to be effective, probably because they reduced the visual stress. But the individual adapted glasses were more effective. The result of this study underlines the connection between a decrease of migraine attacks and a reduction of visual stress of the brain.

Keywords: correction of color-perception, migraine**.**

INTRODUCTION

Migraine attacks are a significant burden and restrict the affected persons in both professional and private life. Nausea, vomiting, dizziness and blurred vision or paralysis may be symptoms of severe headache [1]. Currently, there has been only one solution which is proven to be effective in the long-run in fighting migraine: pharmacological therapy. Side effects and painkiller-induced permanent headaches do not always ease the pain for those affected and many long for an alternative therapy.

In a previous pilot study by Ruschenburg, Jobke and Kasten [2], it was examined how colored lenses affect different disease patterns, including migraine. The authors found a significant improvement of symptoms.

Goal of the current study was to check the effect of colored lenses specifically for migraine. The basic assumption is that some (but clearly not all) people suffer from migraine due to color recognition weakness, which in addition with other factors, overloads the brain and causes headaches. Therefore, at first, the subjects of this study were tested for a deficiency regarding color recognition. In the experimental group, this was then compensated for, by individually matched colored glasses. During the eight-

week investigation period, participants were scanned to examine whether there was a decrease in the number of weekly migraine attacks.

Color and Psyche

Colors influence us significantly in everyday life, often without us being directly aware of it. E.g. Lüscher [3] developed a test in which a subject has to choose between different colored plates, and the individual preferences then can lead to conclusions about the personality. E.g. Lüscher [3] already said that the color of nutrition products has a significant influence on our consumption patterns. He also points that colorful and nicely designed products are sold more than colorless pale packaging. Today consumers associated muted colors with a product that is beneficial for health and free of pollutants. Frieling [4] states that a completely white design of the workplace can have rather negative impacts and can be strenuous for the eye. He recommends: *"(...) to choose the working chairs strongly colored (e.g. reddish brown, orange)*". Frieling mentions for example, that equally high ceilings can appear different in height by different color designs.

The relevance of colors and light on the psyche is not a new topic. Already in 1950 Birren had published his works on "*Color Psychology and Color Therapy*". He assumed that introverted people prefer rather cold colors in contrast to extraverted people who are more inclined to choose warm colors. According to Birren [5] red and it's tones appear to be warm, active and exciting to the viewer--but can also be associated with danger. Some shapes of blue, violet and green can be recognized as cool and soothing. White, for example, acts pure and youthful on humans. Birren [5] refers to the fact that light influences the human metabolism and, together with color, can have a beneficial effect on the organism. He also drew links between mental and physical well-being. Thus, he assumed that mental health and physical activity had positive effects on the vascular and muscular system as well as blood pressure.

It is known that light therapy affects the Melatonin-metabolism and thus can have a positive effect on a winter depression [6-8]. The term "*color therapy*" is dedicated to the psychologist Karl Ryberg [9]. Here, a small room is illuminated by projectors, so that the patient, who sits in the center, is surrounded by light from all sides. A session takes about 20 min. In principle, the aim is to allow the organism to absorb the monochrome light and to have a positive effect on the emotions and, according to Ryber [9], "*partly on the microbiological cell level*". Positive effects were described for e.g neurotic and psychosomatic complaints, restlessness, anxiety, phobias, insomnia, migraine, stomach diseases, muscle cramps, eating disorders, exhaustion and fatigue [6- 8].

Disturbances of color-vision: Influence on migraine

A migraine attack usually consists of four phases: Prodrom or announcement symptoms, aura, headache, and postdrome [10, 11]. In addition to severe headaches, many of the affected persons suffer from equilibrium disturbances, consciousness disorders, and abdominal pain or cramps. Women are much more likely to be affected than men [12, 10]. According to Förderreuther & Straube [13], various trigger factors are recorded, e.g. stress, hormonal changes, irregular food intake, alcohol consumption, certain odors, smoking, jetlag and a disturbed sleep-waking rhythm, bright light or heat.

Harle and Evans [14] investigated the visual aspects of a migraine disorder. Most sufferers are very sensitive to light when the headache occurs [15], and retreat into dark rooms. Visual stress can lead to migraine attacks. E.g. looking at certain patterns, such as black and white stripes, puts the brain under stress and leads to hypersensitivity of the visual cortex. Huang *et al*. [16] investigated whether colored filters can counteract this problem. In their study eleven migraine patients and eleven subjects similar in age and gender, who did not suffer from migraine, were examined. The participants had to look at stress-inducing and non-stress-inducing stripe patterns, each with grey glasses, glasses and with so-called pots-precision ophthalmic tints (POT). For this purpose, the subjects worked with the "Intuitive Colorimeter". It allows immersing a text in specific colored lights. The participants had to choose the most pleasant shade with the least visual distortion of perception. This color was then adjusted to the POTs. The non-stress-producing strip pattern proved to be unobtrusive; there were no differences between the individual glasses and the experimental and control group. If the glasses with grey coloring and the colored glasses were used together with the stress-producing strip pattern, a higher cortical activation was shown in the experimental group than in the control group. In comparison to the other lenses, the patients using POTs show a reduction of the cortical activation, which is supposed to be responsible for headaches.

In a double-blind randomized study, Wilkins and co-authors [17] examined 17 patients. For a time period of 6 weeks these subjects got glasses which either optimally brought out the colors under normal light irradiation (optimal tints) or with a slightly modified coloring (control tints). The results of this study, however, were rather disillusioning. It became apparent that the frequency of headache attacks was hardly lower when the "optimal tints" were worn, compared to the "control tints".

In a previous study of Ruschenburg, Jobke and Kasten [2], patients with disturbances of color vision (n=13 patients), migraines (n=14 pat), epilepsy (n=3) and dyslexia (n=52) were tested. In their study, to make a color correction, contact lenses or eyeglasses were

used (Chroma Gen manufactured by Cantor & Nissel). The authors found a considerable positive effect on the frequency of headaches. In addition, in this study the patients showed an improvement in the ability to remember numbers, and to memorize syllables better. There was a reduction in seizures in the case of one participant (i.e.: instead of having to suffer a seizure every two months, she was completely free of complaints during the seven months with glasses).

Aim of this study

Based on these studies, this presented work had the goal to investigate, whether (1) in the experimental group the number of migraine attacks per week is reduced statistically significant due to wearing individually adapted colored glasses), in comparison to the number of migraine attacks per week before wearing the colored lenses (pre-post-design). (2) Does the control group show a significant lower reduction of migraine attacks per week compared with the experimental group (group comparison)? (3) Is there any influence of colored lenses on the results of the Ishihara test?.

METHODS

The patients of the two groups were asked to wear colored glasses, selected according to the personal preference (experimental group) or slightly mirrored glasses (controls).

The data collection includes (a) a migraine diary to record the weekly number of migraine attacks (b) the Ishihara Tests [18]. The diary asked for the frequency of migraine attacks, the severity of the pain on a scale of 0 – 100, accompanying symptoms and the type of migraine. For the baseline, migraine complaints were recorded during the first 3 weeks, when glasses were not worn. Post-data were recorded then in the next five weeks. Here, the incidence of migraine attacks was recorded, while the glasses were worn at least three hours a day.

Data were collected in Germany in several towns (Hamburg, Marburg, Braunfels-Philippstein, Wilkau-Haßlau and Augsburg). The participants had to fill out a questionnaire [19] about the type of headache. As said above, to count the number of migraine attacks before and after the intervention, migraine diaries were used. The Ishihara-Test [18] was used to investigate whether or not there was a color recognition weakness. Only subjects with binocular vision were taken into the sample.

RESULTS

39 patients took part in the baseline investigation. They were assigned under matched conditions either to the experimental or to the control group. 50% received the actual correction, and the remaining 50% received placebo glasses with a standard shade of 30% gray or brown. The split between the real and placebo groups was based on the date of birth and the ability to recognize colors. We always tried to find two participants of nearly the same age and nearly the same color-ability and placed one of them in the experimental group and the other in the placebo group. The minimum age for participation was 18 years. Nine of this group were male (23.1 %) and 30 were female (76.9). 20 (51.3%) of the participants were assigned to the experimental group, and 19 (48.7%) of them to the control group. Because of drop-outs, to many missing data or other reasons, in the final outcome only the data of 27 participants were available. These subjects were between 18 and 55 of age and the mean age of the total sample was 37.35. The mean age of the experimental group was 38.05 years, and 36.6 years in the control group. In the end, the data could be fully evaluated for 27 participants, of which 8 (29.6%) were men and 19 (70.4%) women.

The statistical evaluation was carried out with the program SPSS (Statistical Package for Social Sciences), the fundamental significance level was α = 5% (i.e. $p < 0.05$). Non-parametric methods (Mann-Whitney-U test) were used to calculate the statistical results due to the small sample size ($n < 30$) and missing normal distribution and variance homogeneity.

Prior to the experiment, there was no significant difference in the number of weekly migraine attacks between the experimental and control group ($p=0.58$, n.s.), but this number was smaller in the placebo-group.

In both groups a pre-post-reduction of the number of migraine attacks was found, but it was significant only in the experimental group ($p=0.04$, see Fig. 1) and missed the significance cut-off in the placebo group ($p=0.06$, see Fig. 2). The difference in the reduction of weekly migraine attacks when comparing the experimental and the control group was not significant (se Fig. 3).

For the Ishihara test data of three subjects of the experimental group and additional three of the control group are missing. For these calculations, the sample decreased to n = 21. In the experimental group there is a significant increase in the number of correctly recognized Ishihara panels by wearing colored glasses compared to the number of correctly read Ishihara panels without the glasses. The pre-post-difference was 2.27 correctly recognized items ($p= 0.01$). In the control group this difference was only 1.56 ($p= 0.14$, n.s.). The difference of the results of the Ishihara test between control and experimental group was 1.58 and showed only a trend, but missed the significance cut-off ($p=0.07$).

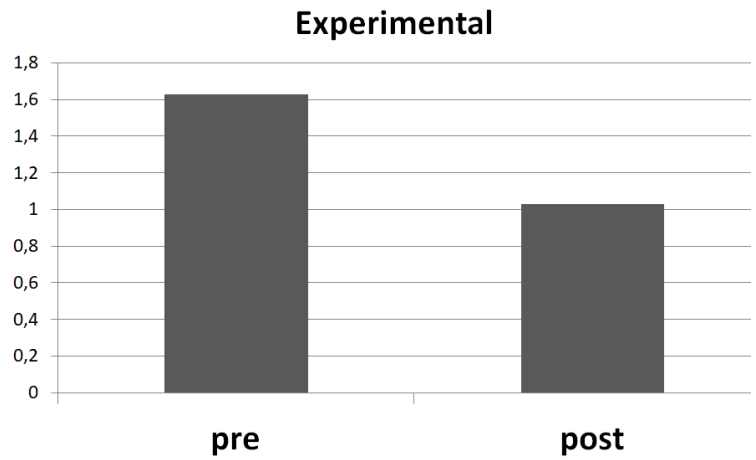

Fig-1: The graph shows the average values of migraine attacks per week in the experimental group before wearing the glasses (left) and in the post investigation after wearing the glasses (right)

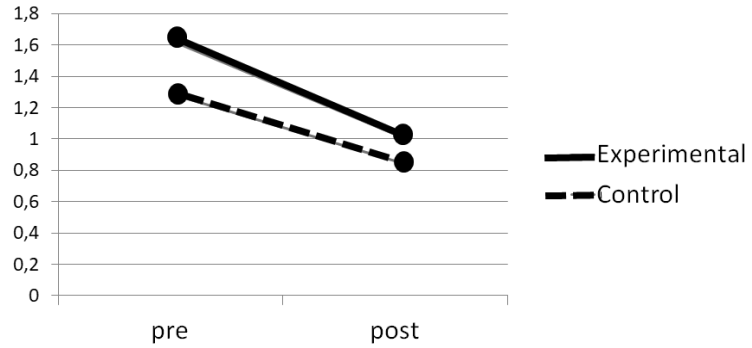

Fig-2: The graph shows the pre-post difference of migraine attacks per week before wearing the glasses (left) and in the post investigation after wearing the glasses (right).

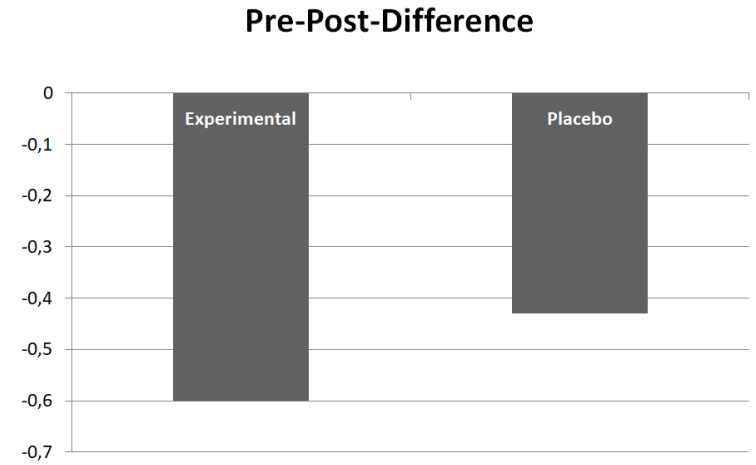

Fig-3: The graph shows the average pre-post-difference of migraine attacks per week in the experimental group (left bar) comparing the pre- and post-difference of the weekly number of migraine attacks in the control group (right bar)

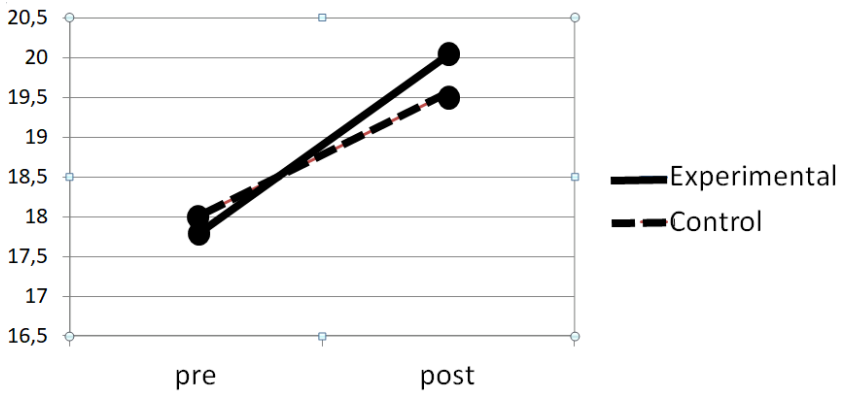

Fig- 4: The graph shows the pre-post difference of correct detected numbers of the Ishihara test before wearing the glasses (left) and in the post investigation after wearing the glasses (right)

DISCUSSION

Several results of the current literature suggest that a weakness of color detection can be an overload for the brain and thus cause headaches. The aim of our study was to investigate a treatment for migraine-patients with deficiencies of color recognition and to develop an alternative therapy to the existent drug treatment. Based on the pilot study by Ruschenburg *et al*. [2], which examined the effects of colored spectacle lenses on color weakness, dyslexia, epilepsy and migraine, this study was examining the effect of colored spectacles specifically for migraine patients. As already illustrated in the introduction, this has been studied in other projects. Huang *et al.* [16] found that by POTs-precision ophthalmic tints, the cortical activation could be reduced if the participant gazes on a stress-inducing stripe pattern. These authors believed that an over-activation of the visual areas in the brain is responsible for the emergence of headaches.

To summarize, it can be said that a small decrease of weekly migraine attacks could be recorded by the utilization of colored glasses. This is evident for the experimental group, but the control group is also showing a considerable improvement.

On the basis of the Ishihara test it could be demonstrated that the subject recognizes more Ishihara tablets when wearing the glasses than wearing none. But it must be said, that the Ishihara test has no parallel form, therefore it can't be ruled out that an effect of test-repetition may be responsible for this result.

In our mind the decrease of the number of migraine attacks of the control group is not only a placebo effect. It is a result of several factors, especially the mirroring glasses, which were used as placebo-condition, even increased the contrast of the vision and therefore could have had a real positive effect, too. In addition these mirrored spectacles, which were usually used as sun-glasses, darkened the vision and many migraine-patients complained about being disturbed by bright light. Therefore, wearing this kind of sun-glasses in activities of daily living even may have reduced the visual stress.

To conclude, in patients with deficiencies of color recognition both kind of lenses proved to be effective, because they reduced the visual stress. But the individual adapted glasses were more effective. This underlines the connection between a decrease of migraine attacks and a reduction of visual stress of the brain.

Furthermore, the colored lenses seem to have had a positive effect on the well-being of the subjects. Many subjects expressed a very positive opinion in the post-examination interview and appeared on the appointment wearing their glasses. Feedback from the participants revealed that the colored glasses were very comfortable to wear. In further research on this topic, it would be interesting to explore how exactly the colored spectacles affect the well-being and how this affects an improvement of symptoms.

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