Original Alternative Technique of Iris Fabrication for Ocular Prostheses

MARIUS PRICOP[1], HORATIU BALESCU[2], SERBAN ROSU[1]*, HORATIU URECHESCU[1], ZORIN CRAINICEANU[3]

[1] Victor Babes University of Medicine and Pharmacy, Faculty of Dentistry, Department of Maxillofacial Surgery, 2 Eftimie Murgu Sq., 300041, Timisoara, Romania

[2] Ocular prostheses laboratory Horatiu Balescu, General Ion Dragalina Blvd., 300181, Timisoara, Romania

[3] Victor Babes University of Medicine and Pharmacy, Plastic Surgery Department, 2 Eftimie Murgu Sq., 300041, Timisoara, Romania

The loss or absence of an eye creates not only a functional disability, but also an important psychological impact on an individual's social and professional life. Ocular prostheses are maxillofacial prosthetic devices which are generally custom made to replace a lost eye. Polymethyl methacrylate (PMMA) is the most common material used for manufacturing ocular prostheses. The main component of the ocular prostheses is the artificial iris that needs to be identical to the healthy one. For this reason manufacturing the iris is a challenging task for the maxillofacial anaplastologist. The main procedure used in manufacturing the iris is the manual painting technique which can be time consuming and susceptible to error, mainly regarding the color matching. The subject of this article describes an alternative technique of manufacturing the iris. This technique involves using a digital photographing image of the healthy eye which is edited and printed on photographic paper and it seems to offer good esthetic results being less complicated compared to the conventional manual painting technique. The main deficiency of the method is the color distortion which appears after the iris is embedded in the ocular prosthesis. This is caused by an alteration of the photographic paper during the final polymerization stage of the ocular prosthesis which takes place at high temperature.

Keywords: ocular prosthesis, artificial iris, digital photographic technique

Ocular prostheses are maxillofacial prosthetic devices which are generally custom made to replace a lost eye[1].

Nowadays, ocular prostheses used for rehabilitation of the patients that lost an eye are made from three types of materials. The techniques used in manufacturing these prostheses are different depending on the material [2], [9], [10]. The most common type of ocular prostheses is the acrylic one, followed by the glass and silicon prostheses. The silicon prostheses have limited indications and are not being used on large scale.

The main component of the ocular prostheses is the artificial iris that needs to be identical with the healthy one. For this reason, manufacturing the iris is a challenging task for the maxillofacial anaplastologist. The main procedure used in manufacturing the iris is the manual painting of all the details and shades with different types of pigments on various types of stands such as paper, aluminum disks or acrylic disks. We prefer acrylic disks that are painted using oil paints impregnated in acrylic light curing lacquer. Regardless of what materials are being used, this procedure is time consuming and susceptible to error mainly regarding the color matching[3, 4].

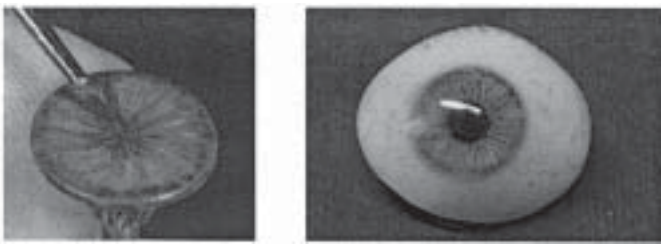

Fig.1. Manual painting of the iris (left) and final aspect of an ocular prosthesis (right)

The objective of this article is to describe an alternative technique of manufacturing the iris for custom made ocular prostheses.

Experimental part

Material and method

This alternative method has been developed by trying to replace the manual painting of the iris. It involves processing a healthy iris photograph in a photo editing software. After processing, the image of the iris is printed on a photographic paper and embedded in the custom made ocular prosthesis [5, 6].

A crop sensor DSLR camera with a 100mm macro lens was used to photograph the healthy iris. Natural light, different types of photo flashes or a dedicated macro flash was used to take the photograph. Different methods of photography were tested and the one with the most natural results was chosen[7, 8].

Finally, the photograph of the healthy iris was taken in standardized conditions using a grey card for correct exposure and a more precise white balance. No flash was used and the image was saved in the RAW format. The images were imported on a computer and the most clear and natural one was chosen for editing in a photo editing software. Other elements that appeared in the initial image, like the eyelids, the eyelashes or light reflections were removed. Also the color, brightness and contrast of the picture were corrected.

In the editing software the part of the picture which included the iris was cropped. A clear part of the iris which did not show light reflections was copied and pasted on the areas which did not corresponded regarding the image quality. The result is a disc which looks like the patient's iris. Adjustments needed to be made to the pupil in order to

* email: serbanrosu@gmail.com; Tel.: +40722313224

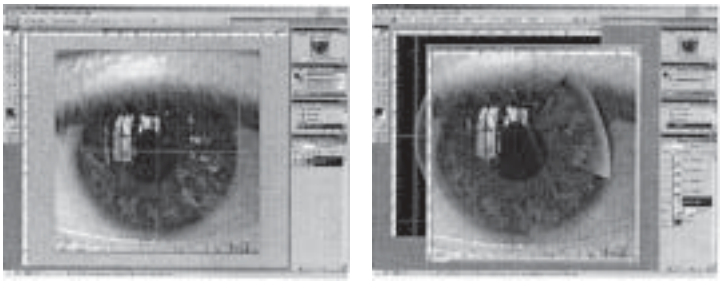

Fig. 2. The image in the photo editing software (left); copying and pasting a clear part of the iris (right)

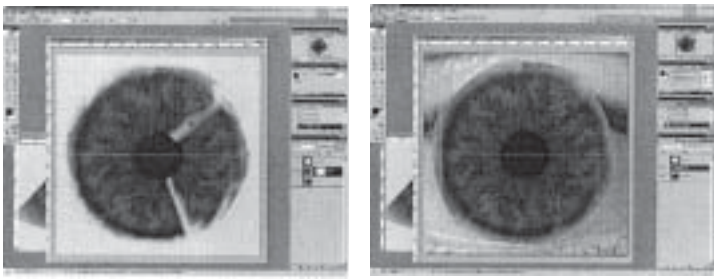

Fig.3. A more advance stage of editing (left); the iris without reflections (right)

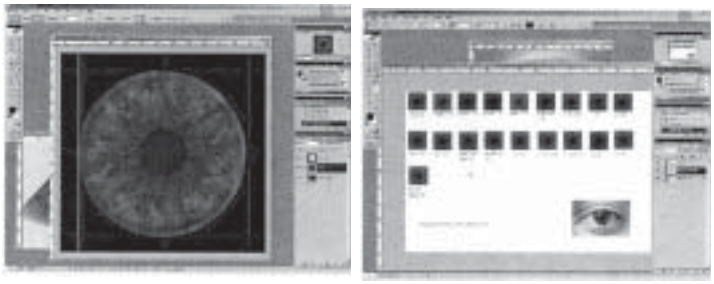

Fig.4. The edited iris (left); multiple copies of the iris with slightly changed image shade, saturation, contrast or brightness before printing (right)

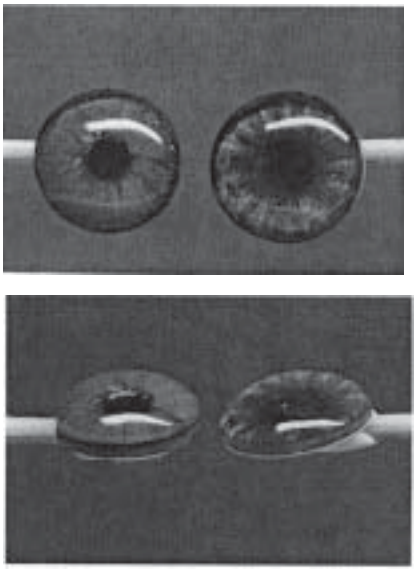

Fig.5. Manually painted iris (up) vs. printed iris (down)

Table I

COMPARISON BETWEEN THE DIGITAL PHOTOGRAPHIC TECHNIQUE AND THE CONVENTIONAL MANUAL PAINTING TECHNIQUE

CRITERIA	DIGITAL PHOTOGRAPHIC TECHNIQUE	MANUAL PAINTING TECHNIQUE
MANUFACTURING TIME	*Less time consuming.*	*Time consuming.*
TECHNICAL SKILLS	*Minimal.*	*Mandatory technical and artistic skills and knowledge of color matching techniques.*
TECHNIQUE COMPLEXITY	*Simple technique.*	*More complex technique.*
ESTHETIC RESULT	*Very good esthetic result with minimal color modifications.*	*Susceptible to error mainly regarding the color matching. Dependent on the painting skills of the operator.*
LONG-TERM BEHAVIOR	*Follow-up is necessary to check any color modification. This type of prostheses is more susceptible to color alteration due to light exposure.*	*Follow-up is necessary.*

be perfectly round and without light reflections. This disc was then calibrated to the same diameter to the healthy iris. Multiple copies have been made slightly changing the image shade, saturation, contrast or brightness. All these copies were printed on photographic paper.

Together with the patient, each of the printed copies was compared to the healthy iris in order to choose and crop the most natural one. On the picked iris a transparent acrylic convex disc was glued using cyanoacrylate adhesive. The acrylic excess was removed and the iris was finished and polished. Then the artificial iris was embedded in the ocular prosthesis.

Results and discussions

The described technique is a simple, practical and less time consuming method of manufacturing the iris for ocular prostheses. The method also requires minimal artistic skills. A comparison between the digital photographic technique and the conventional manual painting technique is shown in table 1.

Over time, the color of the artificial iris continued to change and the differences between the ocular prosthesis and the natural eye became more obvious. Therefore, the ocular prostheses made using this technique needed to be replaced.

Conclusions

Manufacturing the iris is a challenging and very important stage during the custom made ocular prostheses fabrication. Multiple methods and techniques are being described and used, each with its advantages and disadvantages.

Manual painting of the iris remains the traditional technique to which the alternative methods are compared.

The digital photographic technique offers very good esthetic results and is a less complicated, less time consuming, simple and practical method. Furthermore, this method does not require special technical or artistic skills. The only deficiency of the method is the color distortion that occurs after the artificial iris is embedded in the final ocular prosthesis. The color distortion is caused by an alteration of the photographic paper during the final polymerization stage of the acrylic resin. This aspect needs to be further studied in order to avoid this type of deficiencies.

The artificial iris manufactured using the method described above is thinner than the manually painted one and has a more natural aspect because it replicates the patient's natural iris with minimal color modifications.

This technique offers very good esthetic results being less complicated compared to the conventional manual painting technique.

However, some deficiencies of the method were observed when the final prosthesis was inserted in the ocular defect. The main problem was the color differences between the natural and artificial iris. This difference of color was not present when the iris was manufactured. This distortion appeared after the iris was embedded in the ocular prosthesis and was caused by an alteration of the photographic paper during the final polymerization stage of the ocular prosthesis which takes place at a temperature of 100^0C.

In our opinion, these deficiencies can be avoided by using other types of acrylic resins which needs a lower polymerization temperature. In this case the manufacturing method of ocular prostheses needs to be changed to one which is more demanding and complex.

Other alternatives are:

-the coating of the photographic paper after the printing stage with a 100μm laminating pouch in order to prevent any color flowing due to the effect of the acrylic resin [5];

-the usage of an acrylic material instead of photographic paper as a printing support and heat resistant color pigments.

Either way, the technique requires further study in order to be effective and to offer good and predictable results.

References

1.RAGHER M, CHATTERJEE A, Sanketsopanpatil, Chatterjee D, Mallikarjuna DM, Swetha V, et al. Ocular Prosthesis – A Simplified Technique. Austin J Clin Case Rep. 2014;1(12): 1061

2.RAZADA K, RANI D. Ocular Prosthesis Cont Lens Anterior Eye 2007 ; 30(3) ; 152-162

3.NAFIJI BJ, THEERATHAVAJ S, MOHAMMAD KA. A Complete Procedure of Ocular Prosthesis: A Case Report. International Medical Journal. 2013;20:729-730

4.REIS RC, BRITO E DIAS R, MESQUITA CJC. Evaluation of iris colour stability in ocular prosthesis. Braz Dent J. 2008; 19:370-374

5.CEVIK P, DILBER E, ERASLAN O. Different Techniques in Fabrication of Ocular Prostesis. J Craniofac Surg. 2012 23(6):1779-81

6.KUMAR P, AGGRAWAL H, SINGH RD, CHAND P, JUREL SK, ALVI HA, GUPTA SK. A simplified approach for placing the iris disc on a custom made ocular prosthesis: report of four cases. J Indian Prosthodont Soc. 2014; 14(1):124-7

7.PATER LUCIAN FLAVIUS, LEMLE LUDOVIC DAN, BINZAR TUDOR, On Some Yosida Type Approximation Theorems, AIP Conference Proceedings Volume 1168, 521-524

8.LEMLE LUDOVIC DAN, BÎNZAR TUDOR, PATER LUCIAN FLAVIUS, L., Uniqueness and Liouville Property for One-Dimensional Diffusions, Numerical Analysis and Applied Mathematics, International Conference 2010, AIP 1281, 440-444,

9.GHIBAN,N., BORTUN\,M., BORDEASU, I., GHIBAN, B., FAUR,N., CERNESCU, A., Evaluation of mechanical properties by stereo-and scanning electron microscopy of some heat curing dental resins, Mat. Plast. **47**, no.2, 2010, p.240

10. KUSNEROVA M., VALICEK J., HARNIEAROVÁA M., HALUZIKOVA B., SKUBALA P., Physico-mechanical Properties and Electrical Conductivity of Conductive Plastic Materials, Mat. Plast.. **51**, no. 2, 2014, p.150

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