

# ANGIOFLUOROGRAPHY AND TOMOGRAPHY IN THE OPTICAL COHERENCE IN THE MANAGEMENT OF THE DIABETIC MACULOPATHY

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**Cuvinte cheie:**

angiofluorografie  
tomografie in coerenta  
optica  
maculopatie

**Rezumat:** *Lucrarea prezinta aspecte teoretice cu privire la angiofluorografia si tomografia in coerenta optica, doua dintre cele mai valoroase investigatii folosite in monitorizarea pacientului diabetic. Sunt discutate comparativ principiul de functionare, tehnica de efectuare, indicatiile si posibilele complicatii, precum si importanta utilizarii acestor metode in stabilirea unei conduite terapeutice optime la pacientii cu maculopatie diabetica.*

**Keywords:**

angiofluorography,  
tomography in the  
optical  
coherence, maculopathy

**Abstract:** *This paper presents theoretical aspects regarding the angiofluorography and tomography in the optical coherence, two of the most valuable investigations used in the monitoring of the diabetic patient. A comparison between the principle of functioning, the effectuation technique, the indications and the possible complications is made, also the importance of the using of those methods in establishing an optimal therapeutic conduct at the patient & with diabetic maculopathy.*

## SCIENTIFIC ARTICLE OF THEORETICALLY PREDOMINANCE

AFG (angiofluorography) represents a functional ophthalmological exploration having as a purpose the visualization of the choroidian, retinian, iridian blood vessels although of the eye buttock lesions, evidenced after the intravenous injection of a fluorescent substances. The diagnosis of the modification of perfusion is an important element that is taken into account in the stadialisation and the treatment of several ocular affections. AFG brings precise information on the localisation and extend of the lesions observed at the FO examples;

It uses blue light with the length wave of 465 – 490 nm; in contact with fluorescein, appears a yellow-green light with the wave length of 520-530 nm, that may be registered by the photographic pellicle.

The principle of functionation consists in the photography or shot in the contrast substances (fluorescein) that is intravenously injected and realises in the ocular circulation . In the interpretation defers of two important characteristics: the retinian normal vessels aren't permeables fluorescein, and the normal choroidian vessels are permeables at fluoresceins (the choroidian capillaries presents pores); this thing is responsables by the diffuse coloration of the angiofluorographic background.

AFG necesitates the photographic supervision of the passing of the fluorescein through the chorio-retinian vessels. Next to the AFG it may be practiced also the angiography with indocyanine green dye, exploration that permits the study of the subretinian circulation and choroidian contributing especially at the study of the macular affection.

For the anterior pole, AFG is used in: the exploration of the conjunctival circulation, episcleral and irian, the identification of the neofomation irian vessels in the diabetes mellitus (DZ) or the occlusion of the central retinian vein, the differentiation between the irian malign and benign tumors, the monitoring of the vascularity of the interface grephon – host post keratoplasty.

OCT (ocular tomography in the optical coherence) is a modern, rapid, non-invasive and non-contact that allows the obtaining of detailed information on the structure of the retina. OCT permits the correlation of the bottom-eye image with the bi- and tridimensional aspect of the retinal ultrastructure.

It uses the monochromatic light with the length of the wave of 840 nm, closed to the infrared spectrum, so the discomode produced to the patients is minimal. The retina is scanned and then it is analysed the light reflected by the vitros, the retina's layers and the optic nerve.

OCT supposes the obtaining of a image of the retinian ultrastructure with axial resolution (longitudinal) of 6 microns, the values that represent the size of the smaller element that may be differentiated in the image.

The principle of functioning is similar to the ecography, but in the place of the acoustic sounds is used a source of light, and the speed of light propagation is of approximatively 1 million times more rapid than for the acoustic waves.

Due to the big differences of reflectivity contrasts well-defined from the anterior and posterior edge of the retina, the retinian thickness is a easy to follow parameter. It presents the advantage of the quantitative analyse of the layer of the nervous fibers and structures of the optic disc with a good reproductibility;

For the anterior pole, OCT is used in: the imagistic of the angle of the anterior chamber, the management of the glaucoma with closed angle, the screening of keratoconus, applications of refractory surgery, the corneal implants.

The most frequent diseases that are lended to those investigations are: diabetic retinopathy, macular degeneration linked with the age, retinian and choroidian vascular anomalies (hemangioma, aneurisms), benign or malign tumors.

Diabetic retinopathy (RD) is the most frequent vascular disease of the retina. It represents a microvascular complication of the diabetes mellitus and the most important cause of blinding in the population of active age (between 20 and 65

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years) from the entire world.

Retinial edema that threatens or includes the macula may appear in any evolutive phase of the diabetic retinopathy and is produced through two mechanisms:

- The capillary occlusion that produces the macular ischemia
- The growth of the vascular permeability with fluid accumulation and exudate in the macula

In the severe, non-proliferative stages respectively proliferative of the DR and of the macular edema clinically significant is imposed the immediate application of the laser photocoagulation at the level of the eye bottom to prevent the apparition of the complications that determine the loss of sight.

### TECHNIQUE

For the AFG the patient is prepared with at least 30 minutes before the procedure through mydriatic instillations, so the pupils are sufficiently dilatated. The fluorescein is administered intravenously, 5 ml from a solution 10%, during 2-3 seconds. After the administration of the contrast substance seriated photographs of the bottom eye are done (at an interval of one second) with the help of a camera fitted with special filters. After approximatively 45 seconds from the administration, the examiner is fixing the other eye to register the images of the middle phase, then the photographs are done at an interval of 1 minute, at both eyes for the surprinsing of the tardive circulation times of the fluoresceine; as a result of the contrast substance injection, rarely it may appear adverse reactions: nauseas, eructations, rash, generalised itchness, bronchospasm, anaphylactic reactions.

The OCT functionings is based on an optical measuring technique named "interferometry through low coherence"; isn't necessary to the pupile expansion, but for an easier examination midriatic instillation with approximatively 20 minutes before may be done.

A source of light is directionated to the eye and is reflected by the intraocular structures with different optical properties. The intraocular distances and the sizes of the different structures are calculated on the time interval during which the light is reflected by the ocular components.

OCT is easily repetable and it doesn't present risks or complications.

### DIABETIC MACULOPATHY

The aspect of the lesions at AFG:

- focal maculopathy (Fig. 1) - presents as a circumscribed area of "leakage" (tardive focal hyperfluorescence); it is evidentiated edema and complete rings perifoveolare or incompleated by taugh exudation all around a microanevrism;
- difuse maculopathy (Fig. 2) - is observed a generalised "leakage" (precocious stained hyperfluorescence of the microanevrismelor and difuse tardive hyperfluorescence with the maculate "in a flower petal"; is manifested through difuse retinian thickness associated with cystic manifestations, sometimes the fovea being completely covered by edema;
- the ischemical maculopathy(Fig. 3) – the are of non-perfusion is evidentiated through broading and irregular foveolar hypofluorescence; is manifesting through low visual acuity with an apparently normal clinical aspect of the fovea;
- mixed maculopathy (Fig. 4) – appears through the combination of the difuse macular edema with ischemia;

Indications of AFG effectuation:

- in the planning of the clinically significative treatment of the macular edema (EMCS);
- in all the cases in which the deterioration of the visual acuity isn't explained through the canvas of the eye bottom (ischemic maculopathy);
- in the differentiation of the retinian neo-vascularisation of the IRMA;

- the diagnosis and demarcation of the choroidian neovascular membrane;
- the defining of the macular leakage extension after the retinian venous obstructions ;
- the subclinical diagnosis of the cystic macular edema;
- the differential diagnopsis between the neo-vessels and the colateral vessels;
- determination of the under-retinian degree of leakage in the central serous retinopathy;

**Fig.1 Focal maculopathy**

**Fig. 2 Difuse maculopathy**

**Fig. 3 Ischemic maculopathy Fig. 4 Mixed maculopathy**

The aspect of the lesions at OCT :

- Hard exudates (Fig.5) - hyperreflective points with a posterior cone of shade localized at the level of the external plexiform layer;
- Macular edema – the growing of the retinal thickness with or without the erasing of the foveal depression and the hyporeflectivity of the optic sign from the level of the extern retinian layers;
- The cystic macular edema (Fig.6) –liquidian cystic spaces of different non-reflective dimensions with the erase of the foveal depression;
- The pre-retinian membranes – thick hyporeflective bands detached on the anterior retinal layers;
- Tractional retinian foveal decolation (Fig.7) - the posterior hyaloid is attached only at the level of the fovea whose contour appears deformed;

**Fig. 5 Hard exudate**

**Fig. 6 Cystic macular edema**

**Fig. 7 Tractional retinian decolation**

Indications of effectuation of the OCT:

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- in the monitorisation of the therapy answer: the quantification of the retinian thickness, the realisation of the central fovea volume and of the retinian maps, helps at the monitorisation of the therapy effects (LASER, intraretinian injections with Triamcinolon or Avastin);
  - when the surgical treatment is indicated: vitrectomy through pars plana. The secondary cystic macular edema secondary to the foveal traction and the thickening-elongation of the hyaloid membrane isn't benefiting of the laser photocoagulation and represents an indication for vitrectomy;
  - the diagnosis of the pathology of the pigmentary epithelium (EP) and of the choroid: dis-epithelization or breacking of the EP, retinian neo-vascular membranes;
  - the determination of the retinian thickness with or without the cancellation of the foveal depression in the macular edema (diabetic and cystic);
  - the diagnosis and stadialisation of the macular hole;
  - evidentiating the tomographic aspect of the epi-retinal membranes and of the vitreo-macular tractions;
  - measuring the layer of retinian nervous fibers (RNFL), usefull in the precocious diagnosis and pursuing the glaucoma progression;
- International clinical studies have mentioned the characteristics of the clinical significant macular edema (EMSC):
- Any area of edema present at maximum 500 µm of the centre of the fovea (+/- exudate);
  - Retinian edema equal or bigger than 1DP (1500 µm) situated at less than 1 DP of the centre of the fovea;

**THE TREATMENT OF THE DIABETIC MACULOPATHY** necessitated a regular surveillance of the eye bottom, with the examination of the AFG and/or OCT.

- Focal laser photocoagulation of the microaneurisms- is applying in the case of a leakage localised around a microaneurism (the spot characteristics: diameter of 50-100µm, time of 0.05-0.1sec, energy 100mW). It is avoided the avascular foveolar area (ZFA); control at 3 months;
- Photocoagulation in grating of the areas of retinian thickness – represents a strategy of treatment of the difuse macular edema (the characteristics of the spot: diameter of 100-200µm, at one spot distance, during 0.01sec, energy 80-100mW). It is avoided the foveolar avascular area (ZFA); control at 3 months;

## CONCLUSIONS

A precocious and corectly diagnosis, also the evaluation of the laser treatment efficiency requires the use of the angiofluorography and of the tomography in optical coherence as precise and objective methods, indispensable in the monitorisation of the diabetes patient.

AFG offers a topographic image of the retina that helps the establishing of the treatable lesions, but it doesn't evidentiante the changes that appear in the interior of the retinian layers;

OCT confers a image in the interior of the retinal layers and may detect fluid accumulation, formation of cystic spaces, hard exudates and serous decolation of the retina; diagnoses the vitreo-macular traction, hyaloid membrane thickened, tensioned and fibrous pre-retinian membrane.

AFG and OCT are complementary investigations, each having a well established role in the diagnosis evaluation, the therapeutic strategy and monitorisation of the evolution in the diabetic maculopathy.

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