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Optical Coherence Tomography's Contribution to the Diagnosis of the Pathologies of the Vitreoretinal Interface in Lomé

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Abstract

Purpose: To identify the pathologies of the vitreoretinal interface by Optical Coherence Tomography OCT of the retina in Lomé. **Methodology:** This is a retrospective analytical study, carried out in a specialized liberal center in Lomé. It was based on the analysis of OCT images of the retina, carried out with patients between October 2012 and October 2014. The variables collected were the socio-demographic characteristics, which were the various pathologies of the vitreoretinal interface. **Results**: 303 eyes of 164 patients were analyzed. The population was predominantly female (sex ratio = 0.95) aged 9 to 84 years with an average of 52.93 years. 121 eyes (39.9%) had posterior vitreous detachment with 66.1% in the 50 - 70 age group. 42 eyes (13.86%) presented vitreomacular traction with 66.6% in the 50 - 70 age group. 31 eyes (10.23%) presented an epi-retinal membrane with 61.2% in the 50 - 70 age group. 33 eyes (10.89%) had a full-thickness macular hole with 69.6% in the 50 - 70 age group. 4 eyes had a lamellar hole and 1 eye had a pseudo hole. **Conclusion**: OCT is an excellent tool for non-invasive exploration of the vitreoretinal interface. It gives precise information on the various pathologies of this interface. The need to evaluate the functional impact of these abnormalities, calls for other studies, especially prospective studies to assert their reality of those disease.

Keywords

Posterior Vitreous Detachment, Vitreous Macular Traction, Retinal Membrane, Macular Hole

1. Introduction

Optical Coherence Tomography (OCT) is a non-invasive medical imaging technique that achieves high-resolution, micron-scale cross-sections of ocular structures [1]. As soon as it was put on the market in 1996, this examination made it possible to discover or explain certain ocular pathologies better than previously when bio-microscopy and retinal angiography were used [2]. Anatomic zones, previously difficult to explore, have proved more accessible.

The vitreoretinal interface is a complex composite structure. This structure puts in contact the vitreous cortex and the internal retina; this junction zone consists of a dense stowage of collagen fibrils which is superficially inserted into the internal retinal adherent bonds [3]. Its appreciation was considerably facilitated by the advent of this new mode of exploration [4]. The usefulness of OCT in vitreoretinal pathology has been demonstrated [2] [3] [4] [5].

During the last two decades, the OCT has been able to highlight the role of vitreomacular adhesions in the development of many pathologies of this interface [6].

In a 2012 literature review in, Yoreh Barak *et al.* evaluated the role of OCT SD in the diagnosis and treatment of vitreoretinal interface pathologies. This review proposes a consensual classification, based on OCT, to develop a diagnostic identification based on evidence and to facilitate the treatment and prognosis.

This classification includes: posterior vitreous detachment, vitreomacular traction, epiretinal membrane, full-thickness macular hole, lamellar hole, and pseudo-hole [3].

However, in developing countries, not much interest is given to vitreoretinal pathology in prevention programs. The reasons given are their supposedly rare involvement as a cause of blindness, the expensive infrastructures for the management of these pathologies, and the mismatch between the results and the means as well as the efforts made [7]. The pathologies of the posterior segment are becoming an increasingly important cause of visual disturbances, due to the rapid aging of the world population, according to a global report in 2010 [8].

The mastery of the interpretation of OCT images as well as the recognition of pathologies becomes thus a requirement for any ophthalmologist [3].

However, not much is said about the pathologies of the vitreoretinal interface in African literature. To our knowledge, no study has appreciated the role of the OCT in the evaluation of the vitreoretinal interface in Togo.

The objective of this study is to evaluate the contribution of OCT in the diagnosis of vitreoretinal interface pathologies in Lomé by identifying the different pathologies of the vitreoretinal interface.

2. Patients and Methods

Our study was conducted in a private ophthalmologic center located in Lomé, the capital city of Togo, West Africa. It is a retrospective and analytical study on the contribution of OCT to the diagnosis of vitreoretinal interface pathologies in

Lomé. This study ran from October 2012 through October 2014, within a period of 24 months. The study period represents the first two years of use of the OCT in the above-mentioned center.

This study was conducted in compliance with the Helsinki Declaration. Due to the retrospective nature of this study, we could not have the agreement and written consent of the concerned patients.

Included in the study were all patients, regardless of age and sex, who underwent an OCT of the retina. Each OCT image, for at least one eye, had to be of good quality: that is, a signal strength greater than 30. On the images, the posterior hyaloids and/or the internal retina should be clearly recognizable. Not included were all patients who had, during the study period, an OCT of the anterior segment, an OCT of the optic disc, or an OCT of the ganglion cell complex.

We collected all the OCT data of the retina by the same operator The OCT device used was a Topcon 3D OCT-2000 (ver.8.01); however, the examination protocol was standard macular fixation. For each patient included, on the basis of the registered OCT, we have analyzed the socio-demographic data: age, sex, and the presence of abnormalities of the vitreoretinal interface. OCT images were read by two observers, who are all ophthalmologists. The data was entered and processed using SPSS for Windows version 18.0 software. We used the FISCHER X^2 test at 5% threshold for statistical analysis. There were three age groups: ≤ 50 years old, 50 - 70 years old, and >70 years old.

3. Results

3.1. Sociodemographic Characteristics

The patients included in our study were 164. 25 eyes were excluded for absence (05) and poor quality (20) of the image for a total of 303 eyes examined. In the same period, 1085 OCT examinations were performed, all indications considered. Of the 164 patients, 80 were men and 84 were women; a sex ratio M/F = 0.95. The age varied between 9 and 83 years; the mean age was 52.93 years with a standard deviation of 16.02. Figure 1 shows the distribution of patients by age and sex. The right eyes examined were 154 or 51% against 149 left eyes or 49%.

3.2. OCT Characteristics of the Vitreoretinal Interface Pathologies

Pathologies of the vitreoretinal interface include posterior vitreous detachments, vitreomacular tractions, epiretinal membranes, and macular holes. Table 1 shows the different frequencies found in this series.

3.2.1. The Posterior Detachment of the Vitreous

The posterior vitreous detachment (PVD) involved 60 right eyes (19.8%) and 61 left eyes (20.13%), representing a total of 121 eyes (39.93%). Of the 303 eyes examined, we found: 50 stage 1 PVD (16.5%), 30 stage 2 PVD (9.9%), 32 stage 3 PVD (10.56%), and 9 stage 4 PVD (2.97%). The 50-70 year age group was the most affected by the PVD with a total of 80 eyes (66.1% of all PVD). Table 2 shows the distribution of eyes according to PVD stage and age. There was a
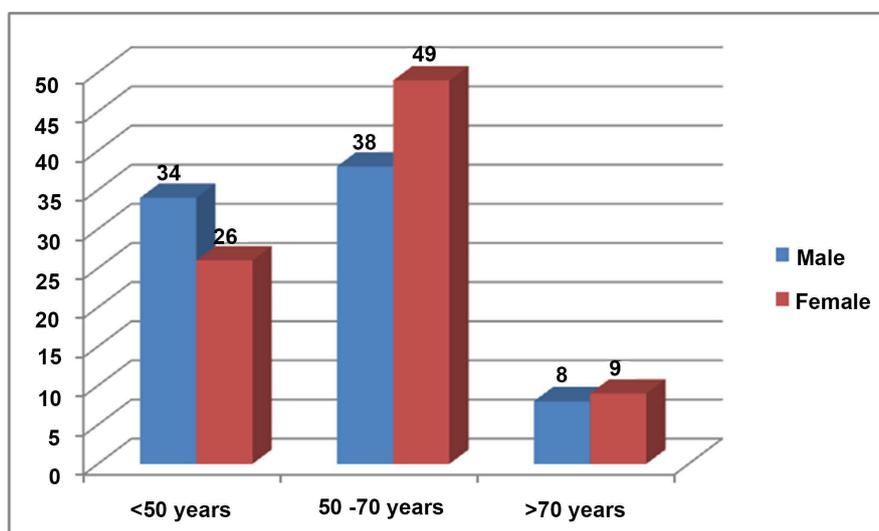
Figure 1. Distribution of patients by age and sex.

Table 1. Distribution of eyes according to the pathology of the vitreomacular interface and age.

	Age			
	<50 years N = 118	50 to 70 years N = 156	>70 years N = 29	Total N = 303(%)
Posterior detachment of vitreous (PVD)				
No PVD	91	76	15	182 (60.07%)
PVD	27	80	14	121 (39.93%)
Vitreomacular traction (VMT)				
No VMT	110	128	23	261 (86.14%)
VMT	8	28	6	42 (13.86%)
Epiretinal membranes (ERM)				
No ERM	111	137	25	72 (89.77%)
ERM	8	19	4	31 (10.23%)
Macular hole (MH)				
No MH	111	133	26	270 (89.11%)
MH	7	23	3	33 (10.89%)

statistically significant difference between the various age groups and the presence of a PVD (p = 0.002), and no significant difference with sex (p = 0.056).

3.2.2. The Vitreomacular Traction

The vitreomacular traction involved 16 right eyes (5.28%) and 26 left eyes (8.58%), representing a total of 42 eyes (13.86%). The 50 - 70 age group was mostly concerned with vitreomacular traction with a total of 28 eyes (66.6% of all tractions).

Table 2. Eye distribution by stage of posterior vitreous detachment and age.

	Age			
	<50 years N = 118	50 to 70 years N = 156	>70 years N = 29	Total N = 303(%)
Posterior vitreous detachment (PVD)				
No PVD	91	76	15	182 (60.07%)
PVD stade 1	14	35	1	50 (16.5%)
PVD stade 2	5	20	5	30 (9.9%)
PVD stade 3	5	21	6	32 (10.56%)
PVD stade 4	3	4	2	9 (2.97%)

3.2.3. The Epiretinal Membrane (ERM)

The epiretinal membrane involved 16 right eyes (5.28%) and 15 left eyes (4.95%), representing a total of 31 eyes (10.23%). The 50 - 70 age group was the most concerned by the ERM with a total of 19 eyes (61.2% of all ERM). There is no statistically significant difference between age groups (p = 0.172) and sex (p = 0.270).

3.2.4. The Full Thickness Macular Hole (FTMH)

The full-thickness macular hole involved 16 right eyes (5.28%) and 17 left eyes (5.61%), representing a total of 33 eyes (10.89%). Of the 303 eyes examined, 11 were found to be macular stage 1a (3.63%), 3 stage 1b macular holes (0.99%), 3 stage 2a macular holes (0.99%), 4 stage 2b macular holes (1.32%), 3 stage 3 (0.99%) macular holes, and 9 stage 4 (2.97%) macular holes. The 50 - 70 age group was the most affected by MH with a total of 23 eyes (69.6% of all MH). Table 3 shows the distribution of patients by macular hole stage and age. There was no statistically significant difference between age groups (p = 0.522) and gender (p = 0.943).

3.2.5. Partial Macular Holes

The lamellar macular hole involved 4 patients: 2 right eyes of a 66-year-old male and a 61-year-old female subject; and 2 left eyes of two female subjects aged 65 and 81 years.

The macular pseudohole was noted in the right eye with only 1 male patient, aged 42 years.

4. Discussion

OCT has revolutionized our understanding of vitreoretinal interface pathologies. The advent of high resolution SD OCT generation gives images close to the histological structure of ocular tissues [9].

A better understanding of the physiopathological processes, by the dynamic approach of the vitreoretinal reports, is thus brought to light by this OCT technology, which is in constant progress. This motivated our study.

Our study took place in a private ophthalmologic center, which is the only center to have an OCT in the country. We believe that the constraints of

Table 3. Eye distribution by macular hole stage and age.

	Age			
	<50 years n = 118	50 to 70 years n = 156	>70 years n = 29	Total n = 303(%)
Macular hole (MH)				
No MH	111	133	26	270 (89.11%)
MH stade 1a	4	7	0	11 (3.63%)
MH stade 1b	0	1	2	3 (0.99%)
MH stade 2a	1	2	0	3 (0.99%)
MH stade 2b	0	4	0	4 (1.32%)
MH stade 3	1	2	0	3 (0.99%)
MH stade 4	1	7	1	9 (2.97%)

geographic and financial access related to this situation may have been handicaps to our study in terms of selection biases. The cost of retinal OCT in this private unit costs 60 USD. The Minimum Wage in Togo is currently 70 USD.

This retrospective study is the first one ever done in Lomé It will mark other prospective studies. Its strengths are the relatively large number of samples and the highlighting of new data on the vitreoretinal interface. Its weakness lies in its retrospective nature and the various biases that might be involved. Another limitation of this study on the vitreoretinal interface is that it does not address either the clinical aspects or the elements of treatment of these pathologies. To our knowledge, black African literature is almost silent on the subject.

The pathology of the vitreoretinal interface is essentially explained by the consequences of vitreous aging. With age, this vitreous liquefies and aggregates by forming pockets filled with liquid in the vitreous gel. The process of liquefaction of the vitreous or synchisis appears around the 4th year of life, and it concerns approximately 1/5 of the total vitreous volume between mid and the end years of adolescence. With age, and especially after 40 years old, these liquefied deficiencies increase in number, size and coalescence. This evolution results in liquefaction of more than 50% of the vitreous gel with people who are 70 years and above. The combination of this liquefaction of the vitreous with the weakening of the zones of strong adhesions, between the posterior hyaloid and the internal limiting one, will constitute a fertile ground for vitreoretinal interface pathologies [9] [10] [11].

The subjects enlisted in our study ranged in age from 9 to 83 years with an average age of 52.9 years. In the US, Meuer *et al.* [12] reported an average age of 74.1 years for a sample of subjects aged 63 to 102 years. The average age difference of more than 20 years could be explained by the difference between the life expectancy of our populations lower than that of the Western countries. Our study also corroborates the advanced age when abnormalities of the vitreoretinal interface are found. We did not note a correlation between sex and the occurrence of pathologies of the vitreoretinal interface.

4.1. The Posterior Detachment of the Vitreous

It is defined as the separation between posterior vitreous cortex and internal limiting. It is an expression of age-related changes in vitre and is capable of inducing a variety of pathological events at the vitreoretinal interface [11]. In our study, the percentage of PVD was 39.9%. Manoj *et al.* [13] in India, for a study of 100 eyes of diabetic patients aged 40 to 80, found 22% of PVD. This observed nuance could be explained by the difference in population of our studies. Manoj introduced diabetes as a criterion of distinction while our sampling was broader.

4.2. Vitreomacular Traction

The progression of PVD, already in Stage II, causes excessive traction on the macula. Such traction is likely to lead to anatomical changes in the contour of the foveal surface, formation of intraretinal pseudocyst, and foveal detachment of the pigment epithelium [10]. In our study, the percentage of vitreomacular traction was 13.8%. Koizumi *et al* [14] in the US found 22.6% traction. In his study, Koizumi focused on 48 eyes with traction or ERM, and analyzed 3D images of their vitreomacular interface. Meuer [12] still in the USA, for 2980 eyes, reported 1.6% of traction. These various results could be explained by the varied aspect of the methodological approaches used in these three studies.

4.3. The Epiretinal Membrane

With the progression of PVD and even in the absence of the Weiss ring, residual vitreous tissue is left on the inner surface of the retina; however, this residual vitreous can proliferate and form an epiretinal membrane at any stage of the retina vitreous schisis [10]. In our study, the percentage of the epiretinal membrane was 10.3%. In a study of 44 eyes with macular edema and ERM, Ophir *et al.* [15] in Israel found 52.2% of ERM. Various studies illustrate the contribution of OCT thanks to its better investigation of the vitreoretinal interface. Nirmalan *et al.* [16] in India and Song *et al.* [17] in South Korea did not use OCT, and reported rates of 1.8% and 1.5% ERM, respectively. In the US, Meuer *et al.* [12] found 34.1% ERM using OCT alone, and Koizumi *et al.* [14] described 67.9% ERM using OCT combined with retinography non-mydriatic.

4.4. Full Thickness Macular Hole

Macular holes are formed by a series of events that are divided into three phases: initiation, expansion, and closure of the hole [18]. Given the variety of hypotheses that have been put forward to explain the pathogenesis of idiopathic full thickness macular holes, the vitreous state remains a constant that is involved in the initiation and progression of these holes. In our study, the percentage of the macular hole was 10.8%. Meuer *et al.* [12], in the US, reported 0.5% with a predominance of the right eye, while in our study there was no difference between the two eyes (16/17). Tanner *et al.* [19] in Great Britain, out of 80 eyes, found 37.5% with a predominance of the stage 3 hole (18 eyes). Yoshida *et al.* [20] in

Japan, for 91 eyes, on the other hand, described a predominance of stage 2 (52 eyes). In our study, the stage I (14 eyes) hole was the most represented.

However, in their studies, Tanner and Yoshida focused only on eyes that already had a hole. Tadayoni [21] proposed, in 2015, a French adaptation contained in the classification of the international vitreomacular traction group.

4.5. Partial Macular Holes

Macular pseudohole and lamellar macular hole are two different entities that constitute a differential diagnosis of the full-thickness macular hole. Their pathogenesis is different. The macular pseudohole is dependent on the centripetal contraction of a ERM, whereas the lamellar macular hole results from an aborted process of hole formation or could be the complication of a chronic macular oedema [22]. In this study, we reported 4 lamellar macular holes and 1 macular pseudohole out of a total of 303 eyes. Massin *et al.* [22] in France reported 29 lamellar macular holes and 40 macular pseudoholes, out of a total of 71 eyes. In USA, Meuer [12] noted 64 lamellar macular holes, out of a total of 2980 eyes. It should be noted that Meuer did not distinguish between macular pseudohole and lamellar macular hole. Unlike our series and that of Meuer, Massin studied only eyes that had been diagnosed either as a macular pseudohole or a lamellar macular hole in biomicroscopy.

5. Conclusion

This study has shown that pathologies of the vitreoretinal interface are not so rare. From this study, it appears that OCT is an excellent tool for non-invasive investigation of the vitreoretinal interface. The posterior detachment of the vitreous is the most frequently encountered pathological situation. Its rate of occurrence is three times higher than that of the vitreomacular traction, the epiretinal membrane, and the macular hole. The age group of 50 - 70 years is the most affected by these pathologies of the vitreoretinal interface. There was a statistically significant difference between various age group and the presence of a PVD while it was not the case with other pathologies. These conclusions call for further prospective studies on the pathologies of this interface, while evaluating their functional impact. Randomization of underlying conditions such as diabetes and age macular disease (AMD) would be particularly attractive.

Conflict of Interest

The authors declare no conflict of interest.

Ethical Approval

Approval for the study was obtained from the National Medical Ethic Committee.

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