Research Article

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Regenerative Medicine

Evaluation of the effect of subtenon autologous platelet-rich plasma injections on visual functions in patients with retinitis pigmentosa

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Aim: The photoreceptors in retinitis pigmentosa (RP) remain in dormant status for a while with a decrease in the growth factors in their microenvironment before apoptosis. Growth factors reduce retinal degeneration and apoptosis in animal models. **Materials & methods:** The data of 188 eyes of 94 patients who were injected with autologous platelet-rich plasma (PRP) into the subtenon space three-times every 2 weeks were evaluated retrospectively. **Results:** Statistically significant improvements in visual acuity, visual field and fixation stability were detected after treatment. When the treatment response of the patients' better-seeing eye compared with the response of the other eye, there was no statistically significant difference. **Conclusion:** The PRP treatment has a favorable effect on visual functions in patients with RP. This approach is promising as it is safe and easy.

First draft submitted: 5 June 2020; Accepted for publication: 4 March 2021; Published online: 23 March 2021

Keywords: growth factor • hereditary retinal dystrophy • platelet-rich plasma • retinitis pigmentosa • visual field

Hereditary retinal dystrophies are the most important causes of irreversible and progressive vision loss all around the world. Retinitis pigmentosa (RP) is the most common type of retinal dystrophies. Nonsyndromic RP is seen in about 1 in 4000 [1]. It is estimated that around 1.5 million people in the world are visually impaired due to this disease [2]. RP is a degenerative eye disease and results in severe vision loss and often blindness. Affected patients experience difficulty in adapting the transition from light to dark in the early stages and night blindness (nyctalopia). As the disease progresses, it narrows the peripheral visual field, causing tunnel vision, and leads to total blindness as the visual acuity decreases gradually. It is estimated that there is a loss of 4–12% of the visual field and a loss of 17% of electroretinography (ERG) amplitude year by year in the natural course of RP [3].

RP is a heterogeneous group of hereditary diseases resulting from abnormalities in the retinal pigment epithelium (RPE) and photoreceptors of the retina. The RPE cells form the blood–retinal barrier with tight connections between them; take part in the vitamin A cycle and are responsible for phagocytosis of the outer segments of photoreceptors. RPE loss can lead to secondary photoreceptor degeneration [4]. Rod photoreceptors are affected primarily and cones are involved subsequently. Although there are lots of mutations and different mechanisms related to the mutations, the ultimate pathway is progressive apoptosis of photoreceptor cells and retinal atrophy.

The genetics of RP are complicated and heterogeneous. There are more than 70 mutations leading to this group of diseases in the records [5]. It can be inherited as autosomal dominant, autosomal recessive, or X-linked type. 30–40% of the cases are autosomal dominant, 50–60% are autosomal recessive, 5–15% are X-linked [2]. To date, 23 autosomal dominant, 43 autosomal recessive and five X-linked RP genes have been identified [5]. As RP is understood to be caused by mostly monogenic changes; stem cell and gene therapy approaches have become promising options and in recent years, these treatment studies have gained momentum to improve or maintain the visual function of patients. Despite the advancements in the molecular biology and genetics of RP, the exact

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pathways of photoreceptor cell death have not yet been clarified for all the mutations. But for the mutations in *RPE65*, it was demonstrated that the dysfunctional isomero-hydrolase enzyme, which participates in the retinoid cycle, is also involved in apoptosis regulation by alternating the expression of Bcl-2 and Bax [6].

In recent years, it has been shown that the photoreceptors in RP remain in sleep mode for a while with a decrease in the growth factors in their microenvironment before undergoing apoptosis. This period is also called a dormant phase, which is a period when the cells are alive but do not function [7–9]. The neurotrophic, antiapoptotic, hemorheological and immunomodulatory effect of growth factors and cytokines on residual retinal cells has been investigated previously [10–13]. Growth factors and neurotrophins have been shown to reduce retinal degeneration and cell death in animal models [14–16]. One of the sources of the growth factors and neurotrophins is platelet-rich plasma (PRP), which is collected from the centrifuged whole blood. Its platelets store granules containing growth factors such as PDGF, EGF, TGF-β, bFGF, VEGF, IGF, PDAF and thrombospondin [17,18]. PRP treatment has been used in ophthalmology for the treatment of ocular surface diseases for a while [19–23]. Recently Arslan *et al.* suggested reactivate photoreceptors in the dormant phase by increasing the level of neurotrophic growth factors in the microenvironment of photoreceptors by subtenon autologous PRP injection in RP patients. The aim of this therapy was to slow down or prevent the death of photoreceptors and slow the progression of the disease. As it was an autologous product and it was applied outside the eye, its risks such as an allergic reaction and infection transmission could be prevented [24].

The purpose of this retrospective study is to evaluate the effects of subtenon PRP injection on visual acuity, visual field, and microperimetry parameters such as retinal sensitivity and fixation stability in a group of a large number of RP patients.

Materials & methods

119 consecutive RP patients who underwent subtenon PRP injection at the Ankara University Faculty of Medicine Vision Research and Low Vision Rehabilitation Center between November 2018 and January 2020 were analyzed in the study. The study was approved by the Ankara University School of Medicine, Ethics Committee and adhered to the tenets of the Declaration of Helsinki (Approval Number is 10-785-19 / 27 May 2019). Written informed consent was obtained from all participants included.

Participants

This is a therapeutic interventional study with a pre- and post-test design. Patients who were diagnosed with RP according to the clinical history, fundus appearance, visual field test, full-field ERG and fundus autofluorescence; 16 years of age or older; and best-corrected visual acuity (BCVA) less than or equal to 1.6 logMAR (0.025 decimal) were included in the study. Those patients who had media opacities, glaucoma or any systemic disorder that may affect visual functions were excluded from the study. The data of 238 eyes of 119 patients who received autologous PRP injections and met these criteria were evaluated. The 25 of 119 patients whose BCVA is under 1.6 logMAR and could not be evaluated by microperimetry and visual field tests due to poor vision and inadequate fixation capacity, were excluded. Therefore, the data of 188 eyes of the remaining 94 patients were taken into account.

Outcome measures

All patients initially underwent a comprehensive eye examination, including BCVA, near visual acuity, slit-lamp biomicroscopy, fundus examination and applanation tonometry and a low vision examination. BCVA was assessed with the Early Treatment Diabetic Retinopathy Study chart.

The microperimetry and fixation analysis were performed with the MAIA microperimetry (CenterVue, Italy) which integrates a high-frequency eye tracker and a line confocal scanning laser ophthalmoscopy for each eye [25]. The light source of the instrument is an infrared superluminescent diode with a wavelength of 830 nm. The scanning laser ophthalmoscopy performs automatic focusing between -15.00 and +10.00 diopters and captures high-quality images continuously throughout the examination. The field covered is 36° × 36°, and the processed image definition is 1024 × 1024 pixels. The real-time image is black and white. Mydriasis is not required if the pupil size is over 2.5 mm [26]. Fixation stability analysis in MAIA can be done by using two parameters, indices P1 and P2, which demonstrate the percentage of points that are inside a circle of 1° and 2° of diameter, respectively, or by using the Bivariate Contour Ellipse Area (BCEA), which represents the area in square degrees of an ellipse which contains all fixation points. BCEA is calculated considering 63 and 95% points [27]. Each eye was assessed separately for fixation behavior and the average threshold value.

Visual field analysis was performed using the Humphrey Visual Field Analyzer II, model 750 (Carl Zeiss Meditec AG, Germany) with the Swedish Interactive Threshold Algorithm (SITA) Standard test strategy. The 30–2 program and a size III white stimulus on a white background. The Humphrey Field Analyzer allows measurement of parameters that indicate the reliability of tests such as fixation loss, false-positive, and false-negative rates. The tests which indicate a fixation loss ratio of under 20% and the false-positive and -negative ratio of under 33% were taken into consideration.

Intervention

The blood was drawn from the patient's antecubital vein into four 3.0 ml tubes that contain trisodium citrate. Within 10 min, centrifugation was carried out at 2500 rpm for 8 min. The platelet count, which is 150,000–400,000 in microliters, is concentrated ten-times with PRP kits. Thus, 1.5 million to 4 million platelets are obtained in the microliter [28,29]. 1 ml of the bottom layer of plasma (PRP) was drawn by a syringe and injected into the subtenon space of each eye under topical anesthesia.

The injection was performed in the superotemporal quadrant using 25 gauge-needle when patients were looking inferonasally. Autologous PRP was prepared and applied by the procedure described by Arslan *et al.* [24]. The preparation and injection were carried out by the same ophthalmologist. Injections were repeated three-times every 2 weeks. The life span of platelets in peripheral blood is 14–28 days. The installation can be repeated in 2–4 weeks. We preferred to apply subtenon PRP at 2 weeks intervals [28,29]. Baseline tests (BCVA, microperimetry, and visual field) were performed just before the first injection, final tests were performed 2 weeks after the third injection. The visual acuity scores, visual field mean deviation (MD) and pattern standard deviation (PSD) indices and microperimetry average threshold and fixation stability parameters obtained from baseline and final examination were analyzed and compared statistically.

Statistical analysis

Analyses were carried out with the SPSS 22 program. The BCVA values, visual field indices and microperimetry parameters were compared using the Wilcoxon Signed Rank Test. Results were presented as median and minimum-maximum values. P values smaller than 0.05 were considered statistically significant.

Results

Demographical findings

188 eyes of 94 patients with RP were included in the study. The remaining 50 eyes of 25 patients were excluded because of low BCVA (under 1.6 logMAR) values and lack of visual field and microperimetry measurements. Of the 94 patients, 47 (50%) were male and 47 (50%) were female. The mean age was 40.28 ± 14.4 years (range between 16 and 74). Seventeen patients (18%) had Usher syndrome, 2 patients (2%) had Bardet–Biedl syndrome and the others were nonsyndromic RP. The median time since the onset of the disease was 18.5 years (range, 1–55 years).

Change in functional parameters

The median baseline BCVA was 0.7 logMAR and range between 1.6 and 0 logMAR on the Early Treatment Diabetic Retinopathy Study chart (mean BCVA 0.75 ± 0.5 logMAR). The median MD was -30.38 (range between -43.0 and -8.25); the median PSD was 5.17 (range between 1.59 and 12.98) and the median retinal sensitivity as average microperimetry threshold value was 7.6 dB (range, 0.1–27.8 dB) at baseline examination. None of the patients showed cystoid macular edema on the optical coherence tomography (OCT) images.

The mean BCVA was 0.74 ± 0.52 at the final visit. There was a significant difference in BCVA values between baseline and final measurements ($p = 0.036$). The median MD was −29.97 (range between -42.80 and -6.12); the median PSD was 5.21 (range between 1.68 and 14.58) at the final visit (Figures 1 & 2). The differences in MD and PSD indices between baseline and final visits were also significant ($p < 0.001$ and $p = 0.003$, respectively). The median average threshold increased to 7.7 dB (range 0–28.3) 2 weeks after PRP injections, but the improvement in average microperimetry threshold dB values was not statistically significant ($p = 0.91$). The baseline P1 and P2 median values were 18 (range 0–100) and 52 (range 1–100), respectively. The final median values of P1 and P2 were 26 (range 1–100) and 68 (range 6–100) (Figures 3 & 4). Statistically significant improvement in fixation stability parameters was detected after treatment. The increase in P1 and P2 values were significant with p values of 0.001 and <0.001, respectively. The median BCEA value for 63% of points improved from 17.2 to 11.9; the median BCEA value for 95% of points improved from 51.4 to 35.7. BCEA 63% and BCEA 95% values also

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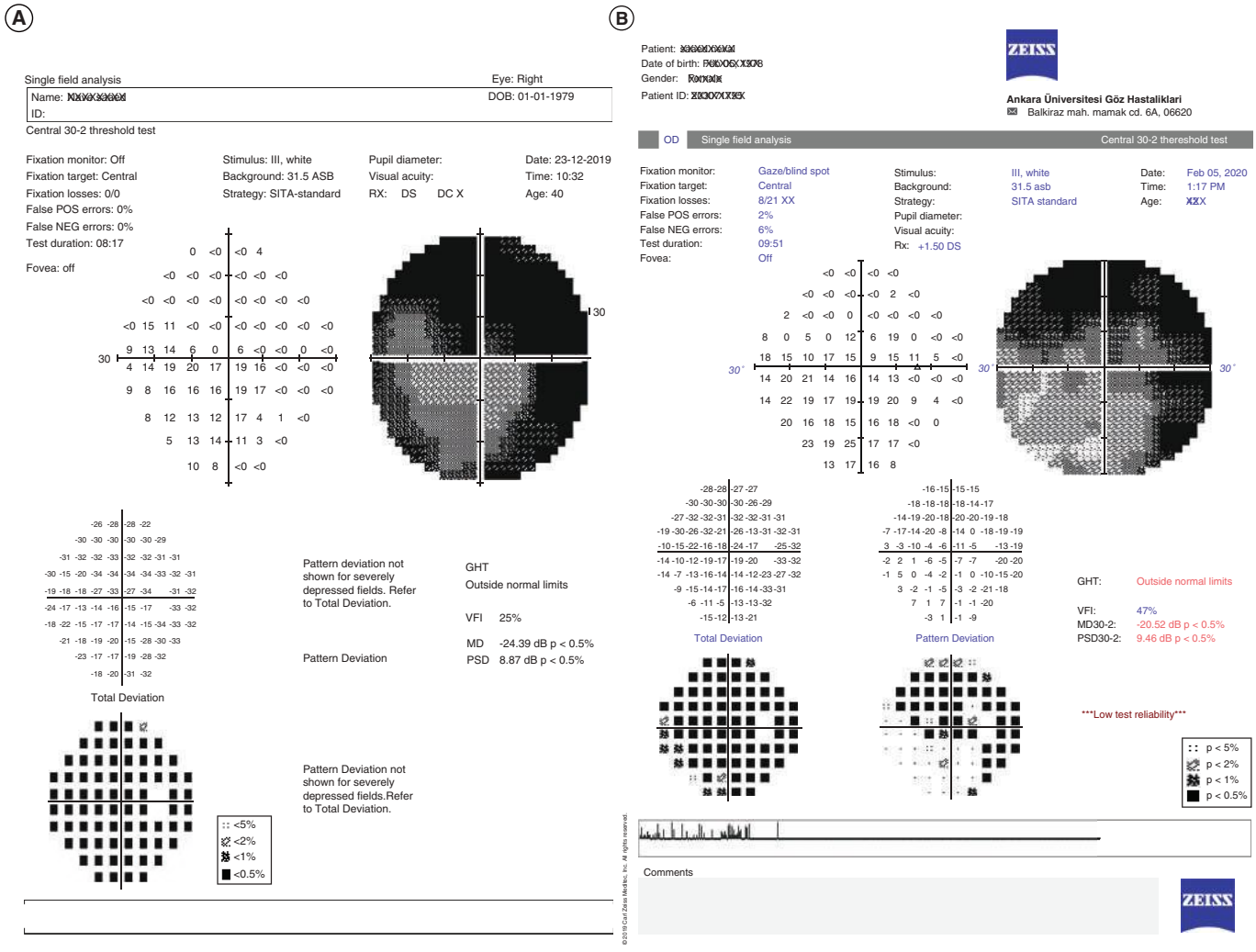

Figure 1. Visual field changes of a 40-year-old patient after three PRP injections. The MD improved from -24,39 to -20,52 in the right eye and MD improved from -24,19 to -17,71 in the left eye. **(A)** right eye, before PRP injections; **(B)** right eye, final exam; **(C)** left eye, before PRP injections; **(D)** left eye, final exam.
MD: Mean deviation; NEG: Negative; POS: Positive; PRP: Platelet-rich plasma; PSD: Pattern standard deviation; VFI: Visual field index.

showed statistically significant increase (p values <0.001). The statistical analysis results of these parameters are shown in Table 1.

Correlation analyses

We considered the MD change after treatment as the treatment response. We evaluated the correlation between baseline BCVA and the difference in MD between before and after treatment, statistically. There was no correlation between baseline BCVA and MD change (r = -0.128 and p = 0.241). We also analyzed the correlation between baseline MD and the difference in MD between before and after treatment by using Spearman's rank correlation test. No correlation was found between the mentioned parameters (r = -0.16 and p = 0.143). When we compared the treatment response of the patients' better-seeing eye and of the other eye, there was no statistically significant difference in MD change (p = 0.47).

Adverse events

We did not see any serious adverse events such as intravitreal, subretinal or macular hemorrhage, retinal detachment, cataract formation, increase in intraocular pressure, intraocular inflammation or allergic reactions during and after the injections. We also did not encounter any ophthalmic or systemic side effects due to subtenon PRP injections.

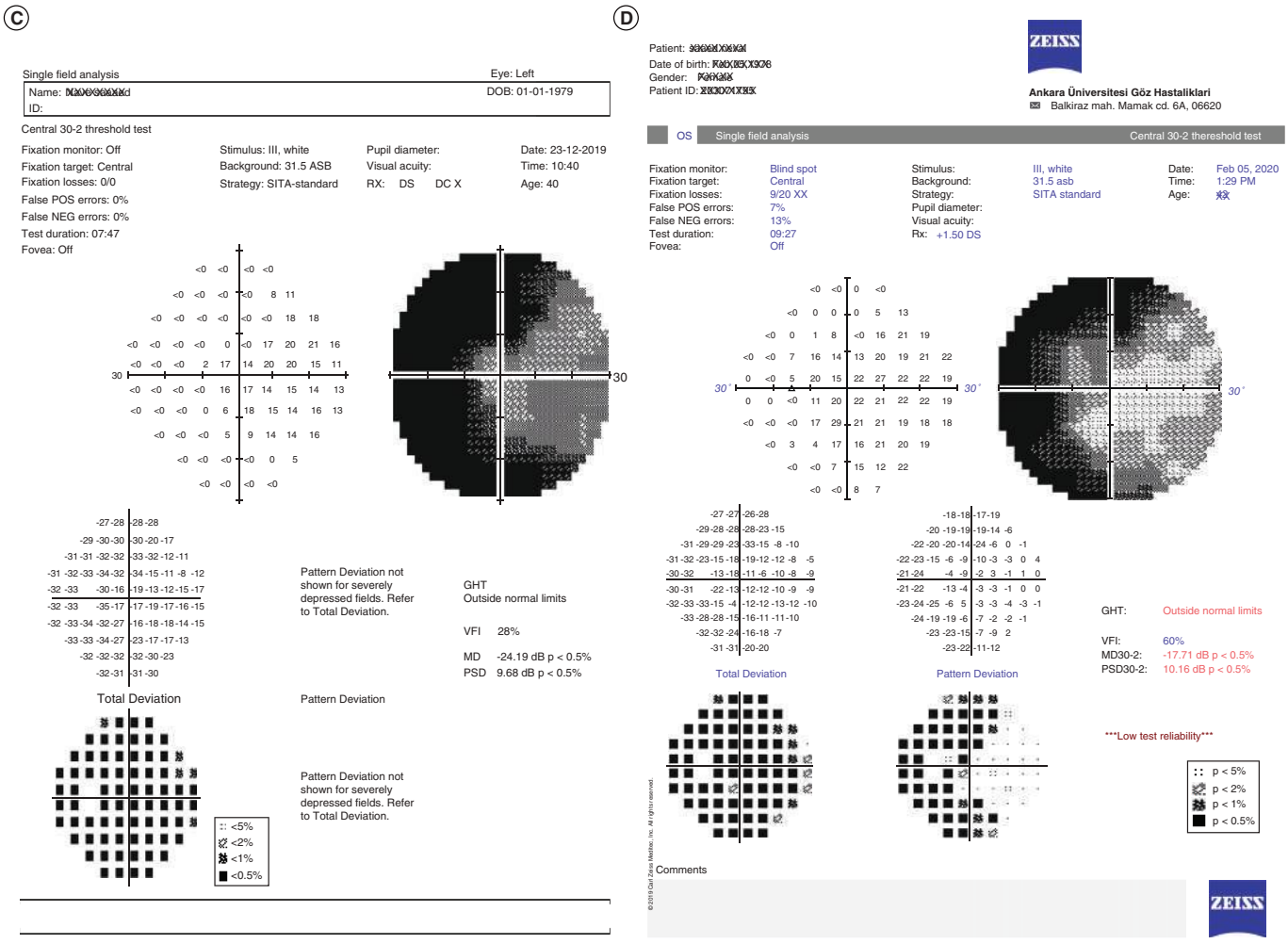

Figure 1. Visual field changes of a 40-year-old patient after three PRP injections (cont.). The MD improved from -24,39 to -20,52 in the right eye and MD improved from -24,19 to -17,71 in the left eye. **(A)** right eye, before PRP injections; **(B)** right eye, final exam; **(C)** left eye, before PRP injections; **(D)** left eye, final exam.
MD: Mean deviation; NEG: Negative; POS: Positive; PRP: Platelet-rich plasma; PSD: Pattern standard deviation; VFI: Visual field index.

Table 1. Comparison of BCVA, visual field MD values, retinal sensitivity threshold values and fixation stability parameters at baseline and final examination.

	Baseline mean ± SD median (min–max)	Final mean ± SD median (min–max)	p-value
BCVA (logMAR)	0.75 ± 0.50 0.7 (0–1.6)	0.74 ± 0.52 0.7 (0–1.6)	**0.036***
Visual field MD	-28.42 ± 5.71 -30.38 (-43.8 – -8.25)	-27.26 ± 7.71 -29.97 (-42.8 – -6.12)	**<0.001***
Average threshold (dB)	9.89 ± 8.87 7.6 (0–27.8)	9.95 ± 8.86 7.7 (0–28.3)	0.91
BCEA 63% ($X^{\circ 2}$)	21.81 ± 21.73 17.2 (0.2–97.6)	16.08 ± 20.79 11.9 (0.1–140)	**<0.001***

*Statistically significant.
BCVA: Best corrected visual acuity, MD: Mean deviation, SD: Standard deviation.

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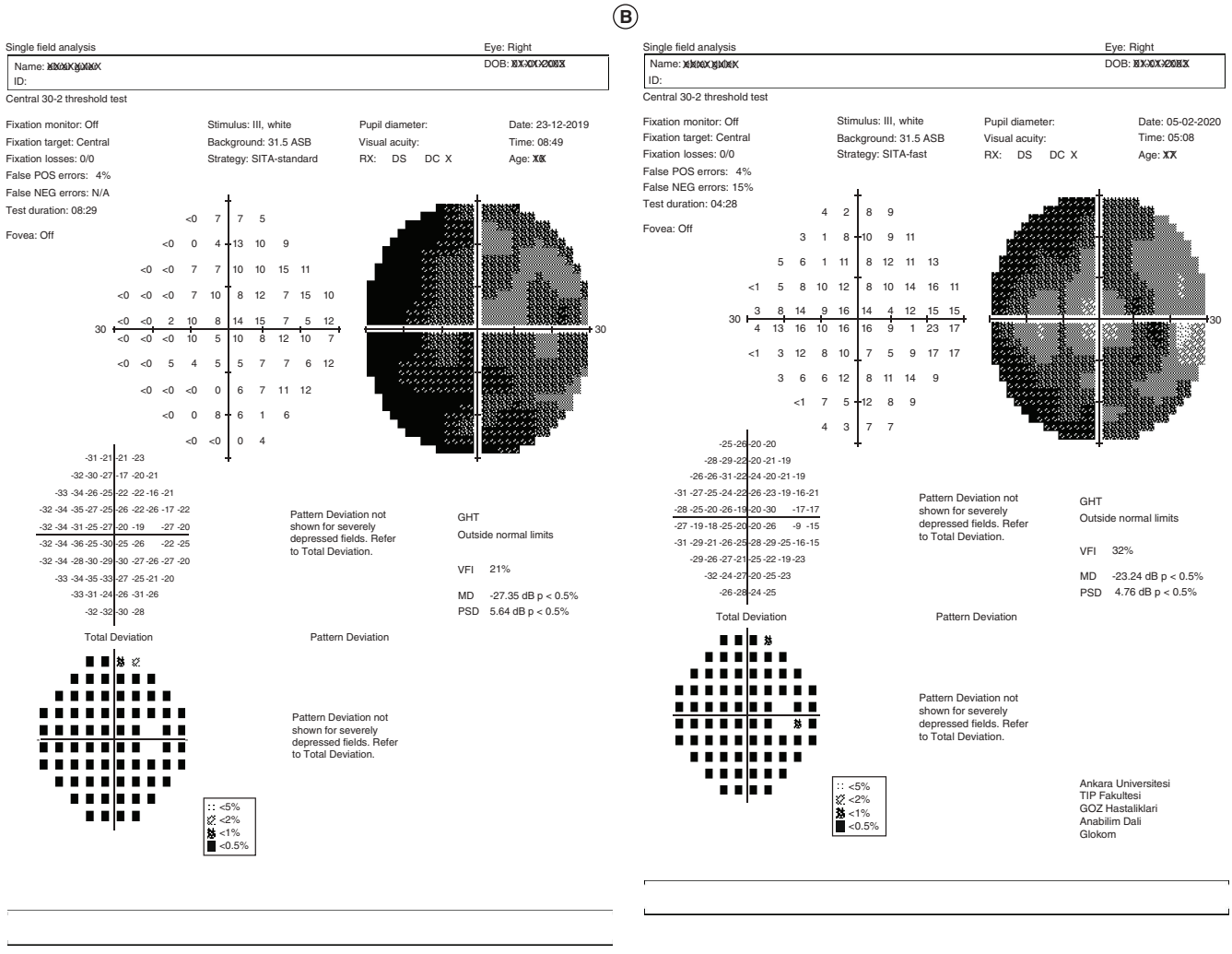

Figure 2. Visual field changes of a 16-year-old patient after three PRP injections. The MD improved from -27.35 to -23.24 in the right eye and the MD improved from -26.36 to -25.53 in the left eye. **(A)** right eye, before PRP injections; **(B)** right eye, final exam; **(C)** left eye, before PRP injections; **(D)** left eye, final exam.
MD: Mean deviation; NEG: Negative; POS: Positive; PRP: Platelet-rich plasma; PSD: Pattern standard deviation; VFI: Visual field index.

Discussion

RP is a hereditary degenerative disease characterized by progressive loss of RPE and photoreceptor cells. It is already known that while the disease is progressing, some photoreceptors die, but the others remain in the dormant phase. The most important determinant of photoreceptors to enter into the dormant phase is the activity of growth factors in the microenvironment. If the level of growth factors decreases, the photoreceptors go into a dormant phase and then apoptosis occurs. In the dormant phase, photoreceptors slow down their metabolic activities. If the growth factor deficiency lasts too long, the cell will go into apoptosis. The time from the dormant phase to apoptosis may vary from person to person depending on genotype [9,30,31]. Growth factors and neurotrophins such as NGF, BDNF and CNTF have been shown to reduce retinal degeneration and cell death in preclinical and clinical studies [14–16,32]. Neurotrophic factors had been shown to play key roles in the development and survival of neurons [33–35]. The amount of NGF, which is a very important neurotrophin, and the number of NGF receptors have been shown to decrease in retinas of animals with RP. The application of NGF preserved retina from degeneration, accelerated the expression of several growth factors and enhanced outer retinal oxygenation [36,37]. Intravitreal injection of NGF also inhibited apoptosis and increased the survival of retinal cells [38].

One source of the growth factors is autologous PRP. PRP is a concentrated sample of platelets in plasma. Platelets contain growth factors and cell signaling proteins in their alpha granules. The main growth factors are

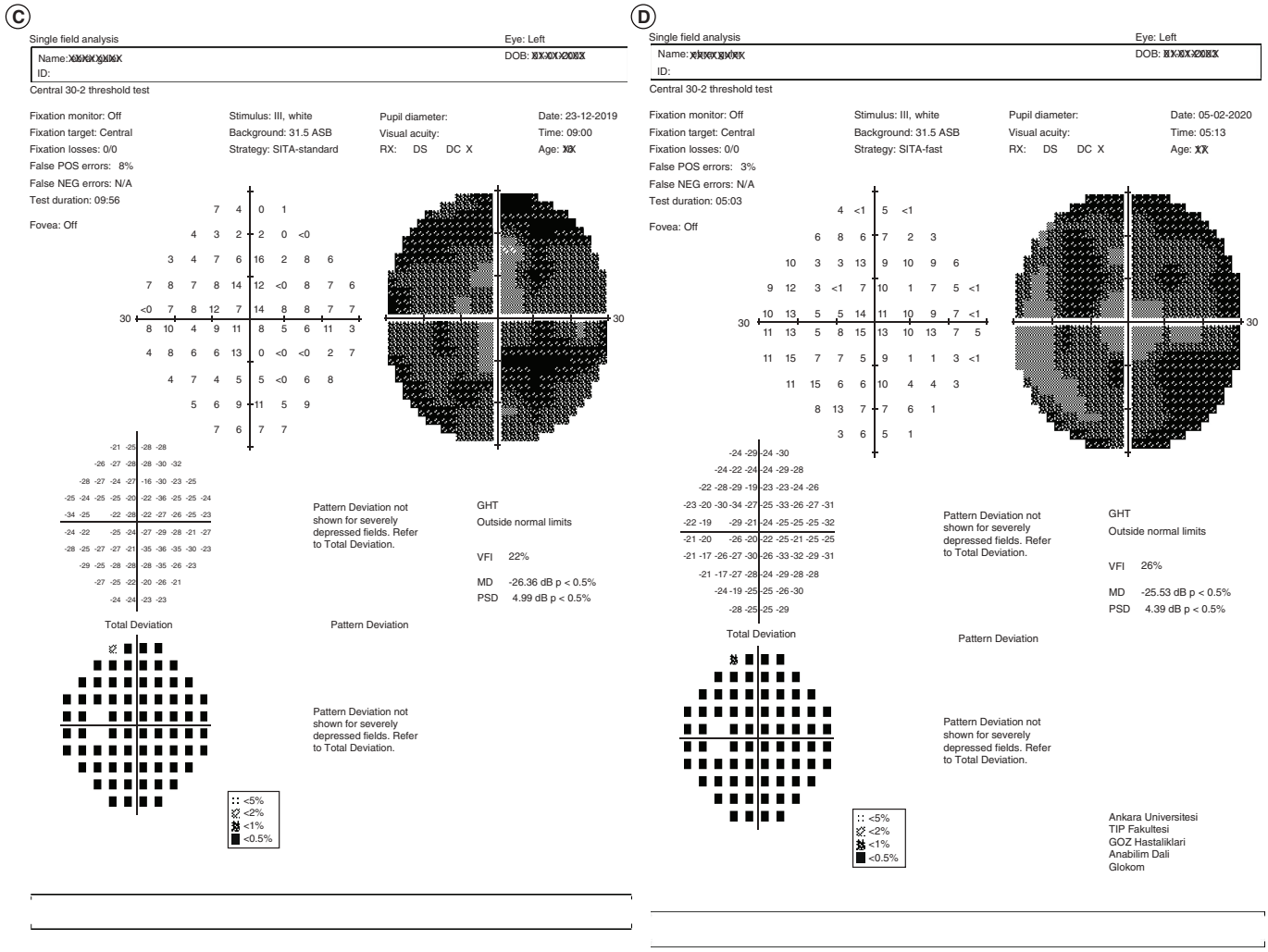

Figure 2. Visual field changes of a 16-year-old patient after three PRP injections (cont.). The MD improved from -27.35 to -23.24 in the right eye and the MD improved from -26.36 to -25.53 in the left eye. **(A)** right eye, before PRP injections; **(B)** right eye, final exam; **(C)** left eye, before PRP injections; **(D)** left eye, final exam.
MD: Mean deviation; NEG: Negative; POS: Positive; PRP: Platelet-rich plasma; PSD: Pattern standard deviation; VFI: Visual field index.

PDGF, VEGF, FGF, IGF, EGF, and TGF-β. These growth factors regulate the cellular energy cycle, capillary blood flow, cellular metabolism and neurogenesis. PRP also has an anti-inflammatory effect due to the cytokines in its content [19,28,39]. In a recent study, Arslan *et al.* conducted a prospective study considering that growth factor supply can be used to improve the status of photoreceptors in the treatment of retinal degenerative diseases [24].

When the platelet-rich part of the plasma is injected to subtenon space, the level of neurotrophic growth factors can be increased in the microenvironment around the photoreceptors. Growth factors applied to the subtenon space pass through the scleral pores to the suprachoroidal area. The passage of growth factors from the choroid to the subretinal space occurs through tyrosine kinase receptors, which have been shown to be more common in places such as limbus, extraocular muscle insertions and the optic nerve in the globe [40]. These growth factors pass through the subretinal space and can reactivate the photoreceptors that are in the dormant phase.

The study of Arslan *et al.* included 71 eyes of 48 patients with RP. While PRP was applied to one eye of 11 patients, platelet-poor plasma (PPP) was applied as a placebo to exclude the mechanical effect of subtenon injection. The application was performed three-times at 3-week intervals. The results were evaluated with visual acuity, visual field, multifocal ERG and microperimetry. An average of 11.6 letters increase was detected in 19 of 48 eyes with baseline visual acuity above 0.1 decimal. In 38 of 71 eyes, brightening of colors, reduction in glare, shortening the time to adapt to darkness, and seeing the environment more clearly were reported subjectively by patients. An

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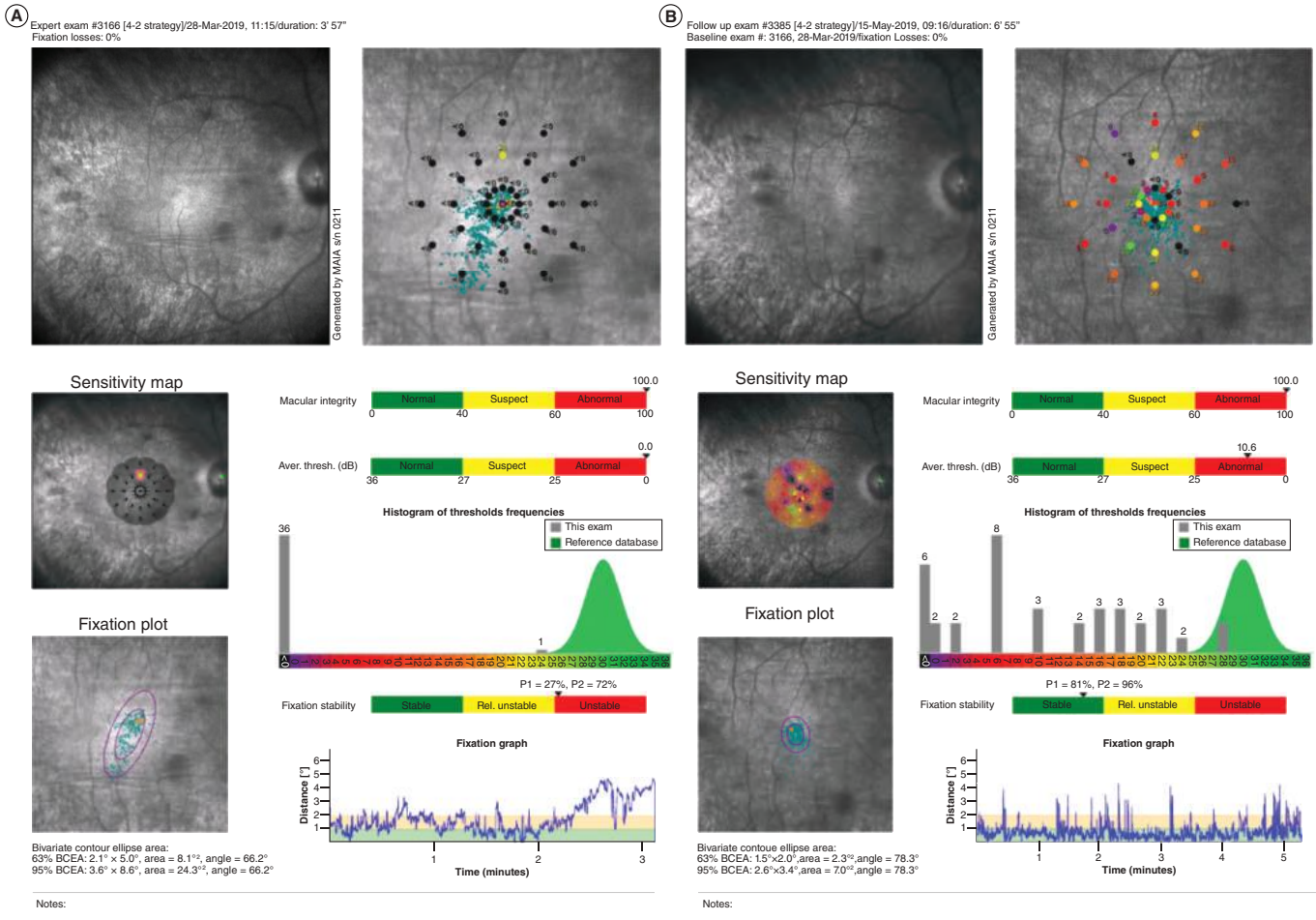

Figure 3. Fixation stability changes in the right eye of a 39-year-old patient after three PRP injections. The retinal sensitivity as average microperimetry threshold value improved from 0 dB to 10.6 dB; the P1 and P2 values improved from 27 and 72% to 81 and 96%, respectively. **(A)** before PRP injections; **(B)** final exam.
PRP: Platelet-rich plasma.

improvement in the visual field (MD values) was observed in 48 eyes with visual acuity above 0.1 decimal. The improvement in retinal electrical responses (in amplitudes and implicit time) evaluated by multifocal ERG was found to be statistically significant. In 23 eyes with macular involvement, a statistically significant increase in retinal sensitivity was detected in microperimetry. There was no statistically significant change in electrical responses in multifocal ERG in eyes injected with PPP as a placebo [24].

Recently, Limoli *et al.* described the Limoli retinal restoration technique, which is the transplantation of autologous mesenchymal cells, adipose-derived stem cells and PRP into suprachoroidal space in RP patients. They provided a nonsignificant improvement in near vision and retinal sensitivity at microperimetry in RP patients with foveal thickness higher than 190 μm compared with the RP patients with a foveal thickness less than or equal 190 μm with this technique [41].

In a recent study of Kahraman *et al.*, improvement was observed in BCVA and visual field after 3 monthly PRP injections in patients with RP, but no significant change in ERG and macular thickness on OCT. In about 50% of the patients, additional injections were needed in the first year due to the deterioration in visual field [42].

A very recent study compared the efficacy of the subtenon PRP and the combination of subtenon PRP and retinal electromagnetic stimulation (Magnovision™, Bioretina Biyoteknoloji AS, Ankara, Turkey) on decreasing the progression of RP. Horizontal and vertical ellipsoid zone and fundus perimetry deviation index reductions were detected lower in subtenon PRP group than in the natural course group and lowest in combination group after a 1-year follow-up period [43].

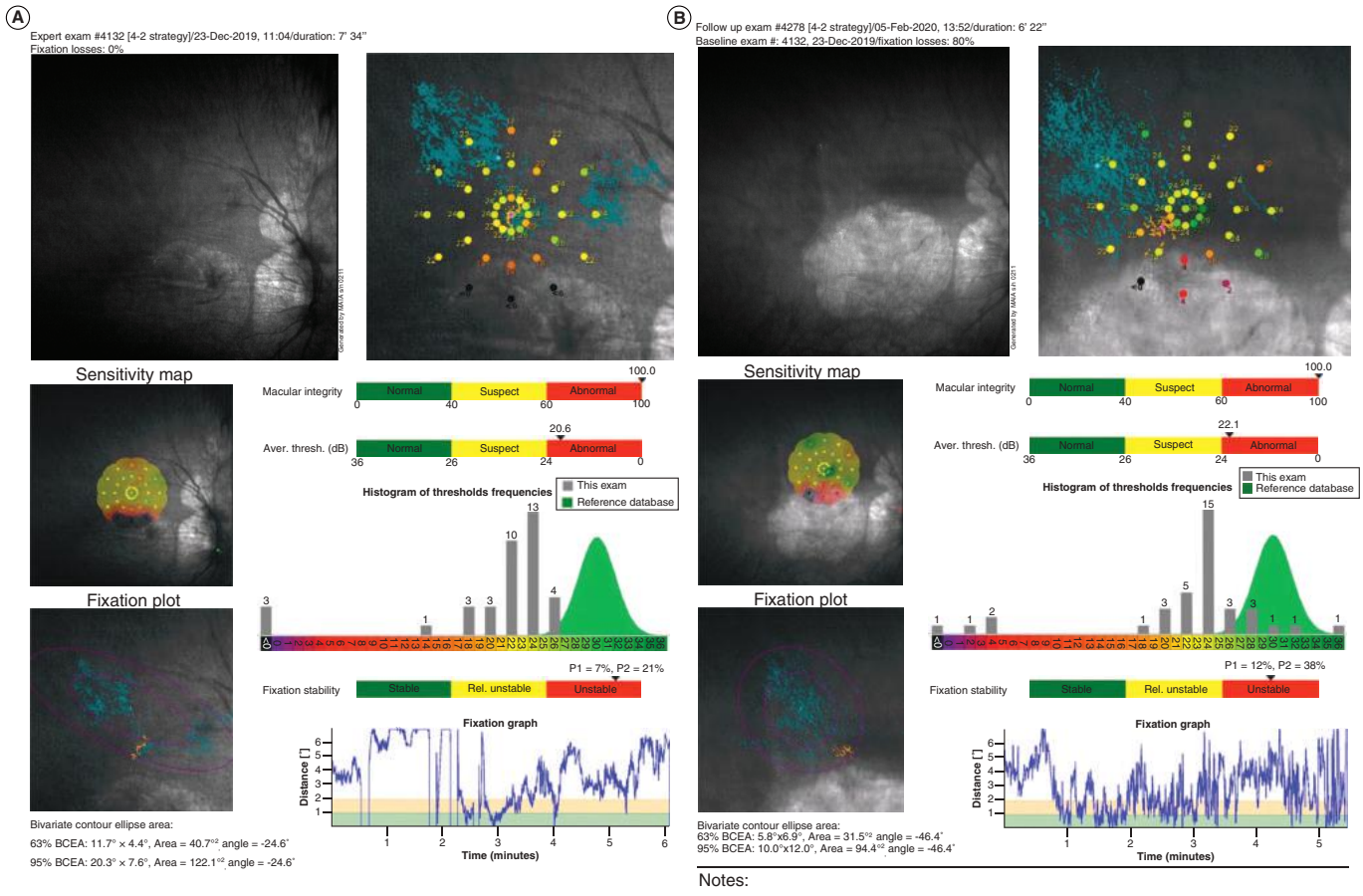

Figure 4. Fixation stability changes in the right eye of a 42-year-old patient after three PRP injections. The retinal sensitivity as average microperimetry threshold value improved from 20.6 dB to 22.1 dB; the P1 and P2 values improved from 7 and 21% to 12 and 38%, respectively. **(A)** before PRP injections; **(B)** final exam.
PRP: Platelet-rich plasma.

In our study, we observed increases in BCVA and visual field MD values. These data confirm that PRP treatment achieved an improvement in visual functions. Fixation stability parameters also showed significant improvement after three PRP injections. The increase in fixation parameters can be explained by the improvement in retinal sensitivity unless the improvement was not found statistically significant.

We hypothesized that the larger the residual cell number is, the greater the improvement of visual function. We used the baseline visual acuity and the visual field MD index as a functional indicator of the number of intact photoreceptors available. We accepted the change in the visual field MD index as an indicator of the improvement in visual function. When we analyzed the correlation between baseline BCVA and the change in MD and between baseline MD and the change in MD, we found no statistically significant correlation. We also compared the better eye and worse eye of the patients, according to the MD change. We could not find any difference in MD changes between the better-seeing eye and worse-seeing eye. There may be other factors such as the type of mutation or other personal features that determine the level of improvement in visual functions.

Retinitis pigmentosa causes photoreceptor loss, but the rate of disease progression varies from person to person. One of the factors determining the annual photoreceptor loss rate has been shown to be the responsible mutation. The annual progression rate of RP has been reported 5% in *RHO* mutation and 15% in *RPGR* mutation [44–46]. Arslan *et al.* reported an annual progression rate of 9.3% in a genetically heterogenous RP group. They also suggested that subtenon autologous PRP injections can decrease the annual photoreceptor loss rate by approximately threefold [43]. We also think that the subtenon injection of autologous PRP has an effect to prevent photoreceptor loss and reactivate the photoreceptors in the dormant phase.

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The effect of subtenon PRP injections is temporary and repetition of injections may be required. As a matter of fact, in the study of Kahraman *et al.* additional injections were needed in 38% of the patients due to changes in visual field, 3 months after 3 monthly subtenon PRP injections [42]. We preferred to perform three subtenon injections every 2 weeks and final evaluation 2 weeks after the third injection. We think that the appropriate time for assessing the effectiveness of the treatment is 2 weeks to 1 month after the last injection since the disease causes rapid functional loss and the effect of the treatment is temporary.

Our study has several limitations. The residual visual functions including the visual acuity and visual field of our participants were very poor. Almost all the patients had a visual field of less than 20 degrees. Patients with better visual functions can better respond to PRP treatment. The lack of a control group with or without a placebo is another limitation of our study. If we had a control group, we could compare the effect of growth factors that may be caused by the surgical trauma of subtenon injection, or we could observe the natural course of the disease. Since there may be a possibility to stop or slow down the progression of vision loss with subtenon PRP injection, it would not be an appropriate approach from an ethical point of view to form a patient group in which the spontaneous course of the disease will be followed without a treatment. In addition, it was not possible to have a control group due to the retrospective design of the study. The most important disadvantage of this treatment is that the effect of the treatment lasts 4–6 months and there is a need for additional injections or longer-acting treatments such as stem cell therapy. We could not include functional results of patients after long-term follow-up and repeated injections in this study. The other limitation of this study was that we only evaluated the visual functions such as visual acuity, visual field and fixation stability but did not follow the photoreceptor functions by full-field ERG testing or evaluate the retinal structural changes by OCT or OCT-angiography after treatment. Since the study was designed retrospectively, the patients did not have ERG test results or post-treatment routine OCT test data. But in a previous study, a significant difference was reported in the horizontal and vertical ellipsoid zone widths measured by OCT in patients who received subtenon PRP treatment compared with those who were not treated, at the end of 1 year follow-up [43]. A study including more detailed evaluation results such as OCT findings including ellipsoid zone width, outer retinal thickness, choroidal thickness and macular edema and full-field ERG changes in patients undergoing PRP treatment is planned.

We had two patients under the age of 18 who had visual acuity below 0.6 logMAR and visual field below 10 degrees. Since the visual functions were very low and therefore requiring interventions for treatment before they were 18 years old, and there is no age restriction for such autologous applications as they are not considered as drug administration, we applied this procedure to these patients. This intervention had already been approved by the Review Board of the Medicine and Medical Device Department, within the Turkish Ministry of Health and in accordance with Turkish law in October 2017 (approval number: 93189304-514.04.01-90670); and the Ethics Committee of the Ankara University School of Medicine in December 2017 (approval number: 21-1327-17).

Conclusion

RP is a hereditary retinal dystrophy that is common in the world and often causes total blindness. No effective treatment has been shown to date. The subtenon injection of autologous PRP has a favorable effect on visual functions. No adverse events or complications were seen in our participants for a 6-month follow-up.

Future perspective

This approach is promising as it is safe, easy and economical. In our opinion with the development of these studies, it will be possible to preserve and even improve the visual functions of patients with RP in the near future.

Financial & competing interests disclosure

The authors have no relevant affiliations or financial involvement with any organization or entity with a financial interest in or financial conflict with the subject matter or materials discussed in the manuscript. This includes employment, consultancies, honoraria, stock ownership or options, expert testimony, grants or patents received or pending, or royalties.

No writing assistance was utilized in the production of this manuscript.

Ethical conduct of research

The authors state that they have received ethical approval from the Ankara University School of Medicine Clinical Trials Ethics Committee. The study was performed in accordance with the Helsinki Declaration of 1964. In addition, all subjects provided informed consent to participate in the study.

Summary points

- Retinitis pigmentosa (RP) is the most common retinal dystrophy that causes of irreversible and progressive vision loss all around the world. Nonsyndromic RP is seen in about 1 in 4000.
- In RP, rod photoreceptors are affected primarily and cones are involved subsequently. Although there are lots of mutations and different degeneration mechanisms that vary according to mutations, the ultimate pathway is progressive apoptosis of photoreceptor cells and retinal atrophy.
- The photoreceptors in RP remain in sleep mode for a while with a decrease in the growth factors in their microenvironment before undergoing apoptosis. Growth factors have been shown to reduce retinal degeneration and cell death in animal models.
- One of the sources of the growth factors is platelet rich plasma (PRP), which is collected from the centrifuged whole blood.
- The aim of PRP injection into the subtenon space was to slow down or prevent the death of photoreceptors and slow the progression of the disease. As it was an autologous product and it was applied outside the eye, there is no risk such as an allergic reaction and infection transmission.
- This study evaluated the effects of subtenon autologous PRP injection on visual acuity, visual field and microperimetry parameters such as retinal sensitivity and fixation stability in a group of a large number of RP patients.
- A significant difference in visual acuity and in visual field after the subtenon injection of PRP three-times every 2 weeks. Fixation stability parameters in microperimetry were also improved after treatment.
- No serious adverse events or complications were observed.
- The subtenon injection of autologous PRP has a favorable effect on visual functions in patients with RP. This treatment is promising for saving vision as it is safe, easy and economical.

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10.2217/rme-2020-0075