Research Article

Evaluation of Visual Field and Balance Function Alterations in Patients Who Underwent Dermatochalasis Surgery

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Purpose. To compare perioperative visual field (VF), balance functions (BF), and changes in the other ocular parameters in patients undergoing upper eyelid dermatochalasis (DC) surgery. Methods. One hundred and fifty-eight eyes of 79 patients who underwent DC surgery were included in the study. The VF, BF, intraocular pressure (IOP), pachymetry (PM), macular, and optic nerve measurements were recorded. Measurements were repeated at postoperative month 1. The preoperative and postoperative ocular measurements and the balance data were compared.

Results. Nineteen of 79 (24.05%) patients were male and 60 of 79 (75.95%) were female, while the mean age of the patients was 58.65 ± 7.38 years. There were statistically significant differences in terms of VF and macular thickness between the preoperative and postoperative values. The improvements in mean defect, standard loss variance, and mean sensitivity values of global VF parameters in both eyes were statistically significant after surgery. Central macular thickness, mean macular thickness, and macular volume decreased significantly in all eyes after surgery (p < 0.05). Conclusions. Although a marked improvement was observed in VF and peripheral vision after surgery, no significant change was found in BF parameters including primarily falling risk. The significant change in the macular parameters was only remarkable, and we think that the decrease was due to subtle vasospasm. There is a need for further comprehensive studies including especially patients older than 65 with a view to understanding the effect of DC surgery on BF.

1. Introduction

Dermatochalasis (DC) is the most frequent cause of acquired pseudoptosis, which causes a decrease in superior visual field (VF) due to the loosening of the upper lid skin, which is folded by the atrophy of the elastic tissue with advanced age [1, 2]. It leads to difficulties in primary sight, reading, and visual functions due to VF defects [3]. In addition, patients may experience issues such as appearing constantly sleepy and having a tired look, loss of self-esteem, and even being perceived negatively in society [4]. Numerous studies have demonstrated positive changes in subjective visual functions and in quality of life along with an improvement in the objective VF after surgery [5, 6].

Posture control depends on the integration of information derived from proprioceptive, vestibular, and visual perceptive systems [7]. Visual acuity, contrast sensitivity, depth perception, and peripheral vision are key visual functions necessary to maintain physical balance [8]. It has been established that especially peripheral vision has a more prominent role in back and forth oscillation of the body when compared to the central vision [9]. Furthermore, the visual component plays a prominent role as a compensatory mechanism in postural stability in situations where there is also proprioceptive inadequacy [10]. It was stated that the risk of falling in elderly people was higher since they were not able to detect the environmental threats because of VF defects [11]. For those people having impaired vision, many vision-dependent activities and daily tasks are difficult or impossible to perform, reducing their ability to perform daily living activities and maintain independence, which has a negative impact on their quality of life [12].

To the best of our knowledge, our study is the first to measure BF, macula, and optic nerve parameters as well in...
addition to perioperative VF, IOP, and PM measurements in patients with dermatochalasis. In particular, we think that BF evaluation will contribute to the literature as it can improve the quality of life in addition to its effect on visual quality after surgery.

2. Materials and Methods

This study was performed retrospectively in Antalya Training and Research Hospital, Department of Ophthalmology, upon the protocol approval by the Institutional Review Board. Seventy-nine patients whose VF and BF were measured before and after DC surgery were included in the study (Figure 1). The patients who had ocular diseases related to an existing pathology, blepharoptosis associated with decreased levator function, psychiatric diseases, diseases of the vestibular system, central, or peripheral nervous systems which might affect BF and the patients who were unable to comply with the VF and static posturography measurements, unable to stand up without support or auxiliary devices, and pregnant or nursing mothers were excluded from the study.

During the surgical procedure, before the sterile prepping, incision line was drawn while the patients were in the sitting position. While drawing the upper crease line from the corner of the eye to the highest point of the midline, we made sure that the length was 7-8 mm for male patients and 9-10 mm for female patients.

For patients who were compatible with fixation reliability criteria before DC surgery and one month after the surgery, mean defect (MD), standard loss variance (sLV), and mean sensitivity (MS) values were assessed by perimetry (Octopus 900 Haag-Streit, Interzeg AG, Schlieren-Zurich, Switzerland). Central macular thickness (CMT), mean macular thickness (MCT), macular volume (MV), disc area, rim area, rim area/disc area ratio (RA/DA), ganglion cell layer (GCL), retinal nerve fiber layer (RNFL) thickness measurements, and also thickness measurements within four quadrants as superior, nasal, temporal, and inferior were assessed by optical coherence tomography (Cirrus HD-OCT 5000, Carl Zeiss Meditec Inc, Dublin, CA, USA). Intraocular pressure (IOP) and pachymetry (PM) values were measured with tonometry (Canon Noncontact TX-20).

BF was measured by computer-based static posturography (Tetrax, Sunlight Medical Ltd.). Posturography is a diagnostic system which analyzes a subject’s balance and the mechanisms employed to maintain balance. This method of posturography is based on the assessment of the vertical pressure fluctuations on four independent force plates, each placed beneath the two heels and toe parts of the subject while he/she stands in an upright position. The Tetrax plates (dimensions: length 25 cm, width 13 cm, and height 8 cm each) are equipped with a strain gauge, the output of which consists of fluctuations of voltage. This output is transformed by an A-D device into a digital signal, which is analyzed by Tetrax software. The weight of the examinee is automatically controlled by the software while height does not interfere with the Tetrax parameters, as shown by systemic examinations [13]. Four basic parameters, which were the stability index (STI), Fourier Harmony Index (FHI), weight percentage and weight distribution index (WDI), heel to toe for the feet, and pressure patterns of left and right foot synchronization, were measured by the Tetrax device in 8 different positions and frequencies, respectively. These 8 different positions are as follows: NO (normal open position: standing straight with eyes open), NC (normal closed position: standing straight with eyes closed), PO (pillows open: standing on pillows, with eyes open), PC (pillows closed: standing on pillows, with eyes closed), HR (head right: standing with the head turned right and eyes closed), HL (head left: standing with the head turned left and eyes closed), HB (head back: standing with tilted backward at a 30-degree angle, with eyes closed), HF (head forward: standing with head tilted forward about 30 degrees, with eyes closed), and the measurement time for each position is 32 seconds.

STI is the numeric variable expression of a patient’s postural defects and controls, which cannot be detected clinically. It evaluates changes in the center of gravity. The total amount of sway from the four footplates (right and left heels, right and left toes) is summed up and then divided by the subject’s weight (the amplitude of the indices of postural sway is affected by vertical pressure; therefore, the division of the postural sway indices by the subject’s weight is used in the posturographic methodology to cancel out the positive correlation of weight to the amplitude). That parameter was calculated as the square root of the sum of squared differences between adjacent pressure fluctuation signals, transmitted by the A-D device and sampled at a rate of 32 Hz for each of the four platforms. Limit values are considered as the standard deviations from 1.5 to 3. Higher values indicate higher imbalance [14, 15].

The FHI is a regression analysis of postural sway intensity through the Fourier transform, which shows a different frequency for each lesion that causes instability. Transformations consisting of four independent wave signals are divided into eight different frequencies and recorded. The FHI evaluates the regression pattern of the eight Tetrax frequency bands. Tetrax program compares the Fourier power values of posturographic performance to a mathematically computed regression curve and evaluates the discrepancy between the graph obtained from the collected data and the theoretical “ideal” regression in the form of a coefficient. This spectral pattern is designated as Fourier Harmony and its coefficient as the Fourier Harmony Index. FHI is the assessment of normal posture performance. Values from 0.9 to 0.99 are the normal limits. If lower values are detected, they indicate problems in the visual, vestibular, and postural feedback mechanism [16].

WDI shows discordant weight distribution in the foot platform and may be an indication of an orthopedic problem. WDI assesses the synchronization pressure patterns of feet and the pressure on the plates where the heel and the toe are placed, while the effectiveness of coordinated movements between the heel and the toes of each foot are also evaluated.

Falling index is used to reevaluate the data. Its algorithm is based on the addition of standard deviation scores, which
are obtained when calculating by how many standard deviations the performance of an examinee deviate from the mean of the normative database provided by IBS software. Adding the standard scores for stability, Fourier intensities of ~0.3 and ~1.00 Hz, and synchronizations, a fall index is graded as minimum falling risk (0–36), moderate level (37–58), high level (58–100), according to which precautions and supportive treatment can be planned [8, 17].

3. Statistical Analysis

All data were analyzed with SPSS (Statistical Package for the Social Sciences) software for Windows (v22.0; IBM, Armonk, NY, USA). Individual and aggregate data were summarized using descriptive statistics including mean, standard deviations, medians (min-max), frequency distributions, and percentages. Dependent variables with normal distribution were compared with Student’s t-test for paired samples. For the continuous variables that were not normally distributed, the Wilcoxon test was used to compare the preoperative and postoperative values. p values <0.05 were considered statistically significant.

4. Results

Out of 79 patients (158 eyes) who underwent upper DC surgery (blepharoplasty), 19 (24.05%) were male and 60 (75.95%) were female, while the mean age of the patients was 58.65 ± 7.38 years (Ranged: 36–84 years). In our study, no significant difference was found between the preoperative and postoperative visual acuity, IOP, and PM for both eyes (Table 1).

When the VF global indicator results were compared; preoperative values of MD and sLV were found to decrease significantly compared to the values of postoperative MD and sLV for both eyes (p < 0.05) (Table 1). Furthermore, preoperative values of MS measured were found to increase significantly after the operation for both eyes (p < 0.05) (Table 1).

According to macular thickness and volume evaluation results; a statistically significant (p < 0.05) decrease was observed in CMT, MMT, and MV values measured in all eyes (Table 2). There were no statistically significant differences in terms of optic nerve head parameters, RNFL, and GCL thickness between the preoperative and postoperative values in both eyes (Table 2).

While the balance functions in STI, FHI, and WDI dimensions were measured in various body, head, and eye positions (Table 3), falling risk slightly decreased after the operation; however, no statistically significant difference was found (Table 3).

5. Discussion

The VF test is applied for legitimizing the blepharoplasty. According to the international standard guidelines, upper
blepharoplasty; therefore, in the light of studies conducted
subjective state and found that the existing entities had a
quality questionnaire postoperatively to assess patients’
evaluated ptosis cases by the margin distance, VF, and life
visual quality after blepharoplasty [22]. Federici et al.
et al. pointed to the improvement in contrast sensitivity and
corneal topography and perioperative evaluation [21]. Kim
develop in patients with advanced dermatochalasis during
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VF test is an important parameter as the visual acuity test
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provement in the visual field of patients alone cannot
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provement in the visual field of patients where they used similar VF global
plasty [18]. Kosmin et al. observed a significant improve-
the VF has to improve by more than 30% after blepharo-
margin-reflect distance should be more than 2.5 mm, and
the VF has to improve by more than 30% after blepharo-
plasty [18]. Kosmin et al. observed a significant improve-
ment after blepharoplasty where they used similar VF global
indexes in their study [19]. However, the objective im-
provement in the visual field of patients alone cannot
completely indicate the subjective perception of visual
quality by patients, changes in visual functions, and in-
creased quality of life. For that reason, studies evaluating
quality of vision and life have been reported. Nevertheless,
the VF test is an important parameter as the visual acuity test
which is used for disability scaling. Even the changes in VF
of patients may reflect the limitations in the quality of life
and thus, have been used as a legal criterion for reim-
bursement [20]. Zinkernagel et al. reported that vision
change might occur as changes in corneal astigmatism
develop in patients with advanced dermatchalasis during
corneal topography and perioperative evaluation [21]. Kim
et al. pointed to the improvement in contrast sensitivity and
visual quality after blepharoplasty [22]. Federici et al.
evaluated ptosis cases by the margin distance, VF, and life
quality questionnaire postoperatively to assess patients’
subjective state and found that the existing entities had a
high correlation [23]. The findings of our study demon-
strated that the decrease in VF might be improved by
blepharoplasty; therefore, in the light of studies conducted

### Table 1: Perioperative comparison of visual acuity, pachymetry, intraocular pressure, and visual field values of all eyes.

| Parameters | Before  | After  | p value |
|------------|--------|--------|---------|
| Visual acuity | 0.970 ± 0.095 | 0.970 ± 0.095 | 1.000 |
| PM | 547.29 ± 26.631 | 545.93 ± 27.085 | 0.270 |
| IOP | 15.562 ± 2.629 | 15.543 ± 2.673 | 0.876 |
| MD | 9.515 ± 4.815 | 4.423 ± 3.495 | 0.001 |
| MS | 17.394 ± 4.883 | 22.408 ± 3.500 | 0.001 |
| sLV | 6.041 ± 2.303 | 3.294 ± 1.679 | 0.001 |

*Student’s t-test for paired samples; Wilcoxon test; *Statistically significant (p < 0.05). PM, pachymetry; IOP, intraocular pressure; MD, mean deviation; MS, mean sensitivity; sLV, standard loss variance.

### Table 2: Perioperative comparison of macular and optic disc parameters of all eyes.

| Parameters | Before  | After  | p value |
|------------|--------|--------|---------|
| CMT | 249.33 ± 20.425 | 247.12 ± 28.368 | 0.043 |
| MMT | 281.62 ± 14.849 | 278.27 ± 18.736 | 0.025 |
| RNFL | 10.141 ± 0.533 | 10.012 ± 0.670 | 0.009 |
| Superior | 94.07 ± 9.542 | 93.58 ± 11.069 | 0.271 |
| Nasal | 116.72 ± 18.545 | 114.16 ± 18.365 | 0.559 |
| Temporal | 71.15 ± 10.993 | 72.26 ± 10.782 | 0.893 |
| Inferior | 64.77 ± 11.446 | 64.08 ± 12.816 | 0.120 |
| Disc area | 123.82 ± 15.928 | 122.53 ± 19.102 | 0.174 |
| Rim area | 1.903 ± 0.314 | 1.911 ± 0.291 | 0.523 |
| RA/DA | 1.427 ± 0.272 | 1.435 ± 0.275 | 0.958 |
| GCL | 0.457 ± 0.163 | 0.465 ± 0.161 | 0.134 |

*Student’s t-test for paired samples; Wilcoxon test; *Statistically significant (p < 0.05). CMT, central macular thickness; MMT, mean macular thickness; RNFL, retinal nerve fiber layer; RA/DA, rim area disc/area ratio; GCL, ganglion cell layer.

### Table 3: Perioperative comparison of balance function measurements.

| Parameters | Before  | After  | p value |
|------------|--------|--------|---------|
| Fall index | 50 ± 26.980 | 48.76 ± 29.894 | 0.889 |
| NO (normal open position) | 0.85 ± 0.144 | 1.77 ± 8.515 | 0.340 |
| WDI | 6.29 ± 3.465 | 6.31 ± 3.515 | 0.974 |
| STI | 21.23 ± 11.717 | 23.93 ± 20.561 | 0.638 |
| PC (pillows closed position) | 0.76 ± 0.174 | 0.81 ± 0.183 | 0.037 |
| WDI | 6.36 ± 3.635 | 6.15 ± 3.324 | 0.685 |
| STI | 20.55 ± 9.639 | 22.21 ± 10.555 | 0.512 |
| PO (pillows open position) | 0.879 ± 0.146 | 0.862 ± 0.139 | 0.082 |
| WDI | 7.689 ± 4.254 | 7.36 ± 4.149 | 0.472 |
| STI | 16.83 ± 8.173 | 16.70 ± 7.959 | 0.962 |
| HR (head right position) | 0.85 ± 0.135 | 0.86 ± 0.116 | 0.873 |
| WDI | 6.32 ± 3.870 | 6.33 ± 4.048 | 0.720 |
| STI | 21.97 ± 11.341 | 22.70 ± 11.156 | 0.343 |
| HL (head left position) | 0.84 ± 0.145 | 0.83 ± 0.177 | 0.949 |
| WDI | 6.37 ± 4.533 | 6.44 ± 3.995 | 0.683 |
| STI | 23.84 ± 10.960 | 23.86 ± 12.515 | 0.656 |
| HB (head back position) | 0.81 ± 0.159 | 0.83 ± 0.161 | 0.214 |
| WDI | 6.48 ± 3.654 | 6.92 ± 4.159 | 0.324 |
| STI | 22.38 ± 11.620 | 24.26 ± 13.783 | 0.118 |
| HF (head forward position) | 0.85 ± 0.137 | 2.05 ± 10.54 | 0.828 |
| WDI | 5.04 ± 3.312 | 6.01 ± 3.613 | 0.135 |
| STI | 22.35 ± 10.066 | 23.32 ± 11.801 | 0.420 |

*Wilcoxon test; *Statistically significant (p < 0.0062). FHI, Fourier harmony index; WDI, weight distribution index; STI, stability index. NO (normal open position: standing straight with eyes open); NC (normal closed position: standing straight with eyes closed); PO (pillows open: standing on pillows, with eyes open); PC (pillows closed: standing on pillows, with eyes closed); HR (head right: standing with the head turned right and eyes closed); HL (head left: standing with the head turned left and eyes closed); HB (head back: standing with tilted backward at a 30-degree angle, with eyes closed); HF (head forward: standing with head tilted forward about 30°, with eyes closed).

before, it might enable a significant improvement in the
quality of vision and life for the patients with DC.

Thirty percent of the population aged 65 and older die or
become permanently disabled due to falling once a year or
more [24]. Every 10% loss in visual field corresponds to an
8% higher risk of falls in adults older than 65 years [25].
Cahill et al. emphasized that loss of peripheral vision was
more highly associated with falls than visual acuity, contrast
sensitivity, stereo acuity, and central visual field loss, and
superior visual field loss was just as important as inferior
field loss [26]. Moreover, Luna et al. demonstrated that the
In conclusion, BF, macula, and optic sinus parameters were evaluated for the first time in our study in addition to perioperative VF, IOP, and PM measurements in patients with dermatochalasis. Although a marked improvement was found in peripheral vision with VF, no significant change was observed in general in BF parameters including primarily fall risk. The significant change in the macular parameters was only remarkable, and we think that the decrease was due to subtle vasospasm. There is a need for further comprehensive studies including especially patients older than 65 with a view to better understanding the effect of blepharoplasty surgery on fall risk and balance functions.

Data Availability

Readers can access the data supporting the conclusions of the study. The data used to support the findings of this study are included within the article.

Additional Points

Précis. Significant changes were not found in patients undergoing dermatochalasis surgery during their evaluation with balance function parameters. Balance function evaluation may provide new approaches to dermatochalasis surgery.

Ethical Approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Consent

Informed consent was obtained from all individual participants included in the study.

Conflicts of Interest

All authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest (such as honoraria; educational grants; participation in speakers’ bureaus; membership, employment, consultations, stock ownership, or other equity interest; and expert testimony or patent-licensing arrangements) or nonfinancial interest (such as personal or professional relationships, affiliations, knowledge, or beliefs) in the subject matter or materials discussed in this manuscript.

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