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# Extraocular Muscle Insertions in Iranian People

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**ABSTRACT**

**Introduction:** To determine the distance of Extraocular Muscle (EOM) insertions to limbus in Iranian people.

**Materials and Methods:** 173 cases (173 eyes) were entered in an observational cross-sectional study. Patients referred to the Khatam-al-Anbia Hospital were included. All of them had to be operated on specific indications. After 360 peritomy in the operating room, the distance between EM insertion and limbus were measured with the same caliper. All measurements were done by the same surgeon.

**Results:** 173 eyes of 173 cases (85 female, 49.13%) with the mean age of 39.70±4.22 years were evaluated.
114 eyes were left eyes (65.89%) and the others were right eyes. The mean and standard deviation of the distances of EM to limbus were obtained as mentioned below: Superior Rectus (SR): 8.63±0.89 millimeter, Inferior Rectus (IR): 6.36±0.40 millimeter, Lateral Rectus (LR): 7.029±0.35 millimeter, Medial Rectus (MR): 5.30±0.37 millimeter.

**Conclusions:** The obtained values will be helpful in vitreoretinal surgery and specifically in strabismus surgery.

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## Introduction

In ophthalmic surgery, specifically in strabismus surgery, accurate measurements of the distances of EOM from limbus are of critical importance (1).

In this regard, different races should be reevaluated in order to provide the information about the field of surgery and show the similarities and differences to the other published studies based on measures obtained from other races (e.g. extraocular muscles transposition in A-V patterns of deviation and advancement of overcorrected recessed muscles in horizontal eye deviations). In addition, in vitreoretinal surgeries, especially in sclera buckling surgery and for muscle hooking during surgery, the knowledge about racial differences can play an important role. The relationship of EOM insertions to limbus were known as spiral of Tillaux (2) which describe the distances as a spiral line that begins from the medial rectus with a distance of 5.5 millimeter to superior rectus with a 7.7 millimeter distance from limbus (2). In this article we are going to evaluate the extraocular muscles insertion in Iranian people and determine the distance of insertion to limbus in order to produce a racial guideline for ophthalmologists.

## Materials and Methods

173 individuals referred to the Khatam-al-Anbia Hospital were enrolled in this observational cross-sectional study. All of them had retinal detachment and had to be operated. Inclusion criteria were the presence of indication for sclera buckling surgery and the need of 360-degree peritomy for doing the operation. The exclusion criteria were the history of previous strabismus surgery and other ocular surgeries with an intervention on extraocular muscles or any operations that could change the distances like primary repair of full thickness globe lacerations. All participants were informed about the project and written consent was signed by each participant.

All the patients were operated on under general anesthesia and after preparation and draping; under sterile condition bulbar conjunctiva was incised with Westcott scissors 360 degrees from limbus. Then two relaxing incisions were done at four and ten o'clock.

Then conjunctiva and Tenon's capsule were dissected from sclera until muscle insertion. The distance between the anterior border of each muscle insertion and limbus (corneoscleral junction behind the conjunctival line of attachment) was measured by a caliper. The same caliper was used for all patients and


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evaluation was done by a single surgeon in order to omit device and interpersonal measurement bias.

Data was gathered and statistically analyzed by SPSS version $_{11.5}$ (SPSS Inc, Chicago). Numerical data was evaluated by student T-test and non-numerical data by chi-square test, and a P-value below 0.05 was considered significant.

## Results

173 eyes of 173 cases (85 female, 49.13%) were evaluated. The average age of patients was 39.70±4.22 years (range 15 to 81 years) with a mean of 37.72±21.89 years in males and 42.20±17.40 years in females. (P-value=0.27 with t-test)

The mean and standard deviation of the distances of EM to limbus were obtained as mentioned below: Superior Rectus (SR): 8.63±0.89 millimeter, Inferior Rectus (IR): 6.36±0.40 millimeter, Lateral Rectus (LR): 7.029±0.35 millimeter, Medial Rectus (MR): 5.30±0.37 millimeter. The distributions of distance of each muscle were obtained. The mean and standard deviation of each muscle in male and female were obtained, and with the exception of the lateral rectus, there were no differences among other muscles. (Table 1)

**Table 1: The mean and standard deviation of muscles distance to limbus in males and females**

| | Male (millimeter) | Female (millimeter) | P-value |
|---|---|---|---|
| SR | 8.75±0.81 | 8.48±0.95 | 0.60 |
| LR | 7.19±0.50 | 6.93±0.43 | 0.008 |
| MR | 5.37±0.45 | 5.20±0.34 | 0.07 |
| IR | 6.38±0.45 | 6.30±0.42 | 0.35 |

102 eyes were left eyes (58.95%) and the others were right eyes. (P-value=0.40) The difference between the distances for medial rectus and inferior rectus were statistically significant. (Table 2)

**Table 2: The mean and standard deviation of muscles distance to limbus in right and left eyes**

| | Male (millimeter) | Female (millimeter) | P-value |
|---|---|---|---|
| SR | 8.65±0.83 | 8.35±0.94 | 0.11 |
| LR | 7.08±0.52 | 8.35±0.94 | 0.88 |
| MR | 5.39±0.44 | 5.21±0.33 | 0.03 |
| IR | 6.47±0.45 | 6.23±0.41 | 0.01 |

## Discussion

The information about extraocular muscle anatomy and precise measurements has an important role in the field of ophthalmic surgery. As mentioned before, previous evaluations were done on specific races and should be used in others with caution because even a small difference can cause a significant change in surgical results. For example, in the surgery of muscle advancement for overcorrected recessed muscles in esodeviations or exodeviations, knowledge about the previous site of muscle attachment in order to realign the eye has the most significance, so every millimeter change in the muscle suturing site can produce a large deviation postoperatively (1,2). On the other hand, knowledge of the extraocular muscles insertional area is important for understanding the physiology of eye movements (3). The range of variations between data reported for extraocular insertion distance to limbus in literature is remarkable (4-6). In this study, we examined 173 eyes intraoperatively.

After a 360-degree peritomy, each extraocular muscle insertion was evaluated, and the distance to limbus was determined with the same caliper by the same surgeon.

85 female (49.13%) and 88 males (50.86%) were evaluated, (P-value=0.81) and there was no statistically significant difference. The mean age of participants was 39.70±4.22 years with the mean of 37.72± 21.89 years in males and 42.20±17.40 years in females. (P-value= 0.27 with t-test) according to Souza-Dias et al, age differences in the distance between limbus and insertion can be neglected in strabismus operations in children older than six months (7).

In our results, there was no significant difference between SR, MR and IR, but the distance of LR was statistically greater in males than in females with means of 7.19±0.50 and 6.93±0.43 respectively (P-value= 0.008), 102 eyes were left eyes (58.95%), and the others were right eyes (P-value=0.40), so being right or left eyed could not impact on the results. There is an interesting finding that between 4 recti muscles, the amount of our measurements for MR: (P-value=0.03) and IR: (P-value=0.01) is significantly different in the right and left eye with the mean of 5.39±0.44 and 6.47±0.45 for MR and LR in the right eye and 5.21±0.33 and 6.23±0.41 for MR and LR in the left eye. To our knowledge, there was no such report for this difference of measurements in the right or left eyes and males or females. We do not have any explanation for this difference, and it needs further investigation.

On the other hand, in similar studies reported before, the measurements were often done on cadaver eyes while we measured the distances intraoperatively so the values can be more precise and more usable for surgeons during ophthalmic surgery (6).

At last, it should be mentioned that the distance of the tendon from the limbus may be influenced by axial refractive errors of the eye, and one of our limitations is that we did not measure the refractive error of participants (8, 9).

In order to conclude this study, there was a difference between the previously accepted spiral of recti muscles insertions to limbus and the values in the Iranian people. It therefore seems that racial differences which can influence the outcome of the operation should be considered during EOM surgeries.

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