



## Influence of Handgrip Exercise on Intraocular Pressure

Authors

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### Abstract

**Purpose:** *The aim of this study is to investigate the effect of handgrip exercise on intraocular pressure (IOP) in young healthy adult males in Tamilnadu population.*

**Background:** *Several studies support the fact that lifestyle modification like exercise has capacity to lower the intraocular pressure and this effect can be used in the management of glaucoma or ocular hypertension along with medication. Most of the previous studies targeted on effect of whole body Isotonic exercise on IOP. This study was initiated to assess the effect of isometric exercise on IOP, a simple measure to postpone the development of glaucoma and its complications.*

**Methods:** *In this quasi experimental study, 44 young healthy adult male subjects of age 18 to 25 years were selected, who fulfilled the inclusion and exclusion criteria. Baseline IOP was measured in both eyes using non-contact tonometer. The subjects were instructed to hold Smedley's handgrip dynamometer with 20% of maximum voluntary contraction in a sustained manner for the period of minimum 2 minutes or until fatigue sets in (Isometric exercise). IOP was measured immediately after the isometric exercise. IOP variation was analysed using paired t test.*

**Result:** *A small but significant decrease in IOP noted immediately after handgrip (isometric) exercise in both eyes with average fall in right eye of 1.70mm of Hg and in left eye of 1.65mm of Hg.*

**Conclusions:** *This study showed that IOP significantly decreased in both eyes after the Isometric exercise using hand grip dynamometer in healthy adult males which can be extrapolated and clinically applied to treat glaucoma patients and its prevention.*

**Keywords:** *Intraocular pressure, handgrip, exercise*

### Introduction

Glaucoma, "The Silent killer of vision" is a forerunner in causing irreversible blindness in India and it occupies the second position in causing blindness in adult population worldwide amounting to about 10%<sup>[1]</sup>. Ocular hypertension is the major cause to provoke the development of

chronic progressive optic neuropathy (glaucoma). By lowering the intraocular pressure we can minimize or prevent the further loss of progressive visual loss. Apart from the medication, many environmental factors have influence over intraocular pressure which can be used for reducing IOP. The most important factor known

to us is physical exertion. So by doing lifestyle modification like physical exercise we can prevent the ocular hypertension.

More number of studies have put forward the correlation of dynamic exercise with IOP changes and it is well known that isotonic or dynamic exercise reduces the IOP [2-5]. Some studies show that Isometric exercise also has the same effect on intraocular pressure like dynamic exercise<sup>[6-9]</sup>. Decrease in IOP is noted after submaximal strength test performance in college students<sup>[8]</sup>. During isometric exercise, intraocular pressure increases continuously as long as the exercise is performed and this increase was seen to be in parallel with increase in systemic blood pressure [6, 7].

The cause for this variation of Intra-ocular pressure with physical exercise is also targeted in several studies. The cause of reduction of IOP after exercise is related to blood lactate<sup>[2]</sup> and also to increase in pulsatile ocular blood flow [10, 11] in case of dynamic or isotonic exercise. In some studies the reduction of IOP with isometric exercise was correlated to hypocapnia<sup>[9, 12]</sup>. It has been shown that isometric handgrip exercise can elicit hyperventilation and it is possible to reduce IOP by handgrip exercise<sup>[13-15]</sup>.

Most of the studies have been done by targeting on the effect of whole body exercise on IOP. No study was done to assess the change in IOP with handgrip (Isometric) exercise in Tamilnadu population with 20% of MVC.

## **Materials and methods:**

### **Subjects:**

Approval for this study was obtained from the Human ethics committee. Healthy male volunteers within the age group of 18 to 25 years were recruited from among the relatives/attenders of patients attending an Ophthalmology outpatient clinic. A questionnaire was used to identify the inclusion and exclusion criteria. The participants with any systemic diseases like cardiovascular disorders, Diabetic mellitus, Hypertension and ocular pathology including refractive errors and subjects with smoking habits, obese subjects, physically trained subjects and subjects receiving medication for systemic/ocular pathologies were excluded from this study.

### **Handgrip Exercise:**

After a brief explanation about the study to the subjects, informed consent was taken. Baseline IOP was measured using non-contact tonometer in both eyes while participant was relaxed and devoid of any physical activities including lid squeezing. Subjects were asked to hold the Smedley's handgrip Dynamometer with the scale facing away from the subject in the dominant hand with forearm in semi-prone and semi-flexed position. After confirming the indicator was in zero level, they were asked to press maximally without any support or hand rest to register the maximal reading on scale. Three trials were taken with the brief pause in between and highest recording was noted as final maximal voluntary contraction (MVC).

After five minutes of rest, subjects were asked to do isometric exercise in dominant hand by sustained pressing of handgrip dynamometer at 20% of their maximum voluntary contraction for a minimum period of two minutes or until fatigue sets in. Immediately following the exercise intraocular pressure was measured in both eyes. IOP was measured throughout the experiment by a single trained technician.

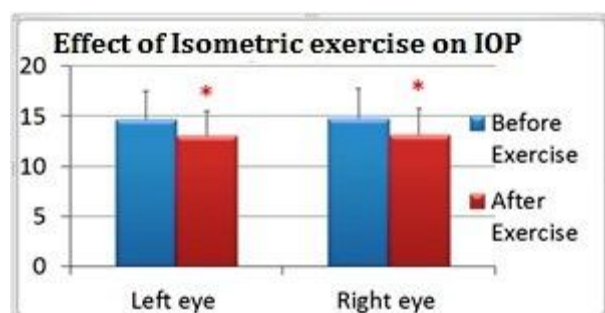
#### Statistical analysis:

IOP, before and immediately after isometric handgrip exercise were recorded and entered in Microsoft excel sheet 2010 for further statistical analysis. The data was analysed using paired t-test. P value < 0.01 was considered to be significant.

#### Result

Among 44 selected volunteers, 88 eyes have been examined; the average age of the volunteers was 21.77. The average MVC of these volunteers was 31.55 Kg. A small but significant decrease in IOP of both eyes seen immediately following the handgrip exercise.

Average fall in IOP immediately after isometric handgrip exercise in left eye was 1.65 mm Hg and in right eye was 1.70 mm Hg and their respective p values are 0.0050 and 0.0064 with being statistically significant.



	Average fall in IOP immediately after exercise	The p values
Left eye	1.65	0.0050
Right eye	1.70	0.0064

#### Discussion

This study shows that single limb isometric handgrip exercise causes reduction in intraocular pressure in the normal adult males among the age group of 18 to 25 years, but still the duration of the effect was not determined. This study included only male subjects. They were selected because this type of isometric exercise is well executed by males. Females were not selected as other factors like different phases of menstrual cycle, pregnancy and menopause influence IOP by means of sex hormones<sup>[16, 17]</sup>.

This study excludes subjects with systemic illness like cardiovascular diseases, diabetes mellitus, ocular pathology including refractive errors and also the persons with personal habits like smoking, alcohol because of their influence over IOP. The persons with physical training were excluded from this study because the reduction in intraocular pressure following exercise was less pronounced in physically trained individuals compared to normal sedentary subjects.

Previous similar studies targeted on only the effect of whole body isotonic exercise and Isometric exercise like bench pressing and weight lifting on IOP. This study carried out to assess the effect of handgrip exercise on IOP using handgrip dynamometer. Before this isometric exercise, maximum handgrip strength or maximum

voluntary contraction of the dominant hand of subjects was noted and isometric exercise done with 20% MVC. One previous study has shown that reduction of IOP seen after handgrip exercise with 50% of MVC<sup>[12]</sup>. Our study data revealed that there was a significant reduction of IOP after handgrip exercise even with 20% of MVC for minimum 2 minutes.

Some studies also targeted on the mechanism of ocular hypotension after exercise. The mechanism of reduction in intraocular pressure after isometric exercise may be hypocapnia as some studies reported reduction of IOP after voluntary hyperventilation. This study has limitations as it doesn't show duration of fall in IOP after isometric exercise and when IOP returns to the baseline. Nevertheless, the long term regular exercise has overall improvement in physical fitness, which appears to be associated with lower baseline intraocular pressure<sup>[18]</sup>. This study supports the idea of regular simple handgrip exercise as an option for those who are prone for glaucoma.

#### Future plans:

- To conduct similar study in larger population with both the sex and to assess the duration and mechanism of decrease in IOP after handgrip exercise.
- To extend the study to assess the effect of handgrip exercise on IOP in glaucoma patients.

#### Conclusion

This study shows that single limb isometric handgrip exercise causes significant reduction in intraocular pressure in both eyes in the normal adult males among the age group of 18 to 25 years. Therefore, it appears that isometric handgrip exercise could be incorporated in the treatment regimen of ocular hypertension and glaucoma along with medication and for prevention of glaucoma in persons who are susceptible for glaucoma. This effect can be also used as a procedure prior to ocular interventions. However, further study to assess the sustained effects of such exercise on intraocular pressure ought to be done before recommending the same.

#### References

1. Quigley, H.A. and A.T. Broman, *The number of people with glaucoma worldwide in 2010 and 2020*. Br J Ophthalmol, 2006. **90**(3): p. 262-7.
2. Harris, A., V. Malinovsky, and B. Martin, *Correlates of acute exercise-induced ocular hypotension*. Invest Ophthalmol Vis Sci, 1994. **35**(11): p. 3852-7.
3. Qureshi, I.A., et al., *Magnitude of decrease in intraocular pressure depends upon intensity of exercise*. Korean J Ophthalmol, 1996. **10**(2): p. 109-15.
4. Vieira, G.M. and E.P. Penna, *The acute effects of resistance exercise on intraocular pressure*. Arch Ophthalmol, 2003. **66**: p. 431-5.
5. Read, S.A. and M.J. Collins, *The short-term influence of exercise on axial length*

- and intraocular pressure. *Eye (Lond)*, 2011. **25**(6): p. 767-74.
6. Vieira, G.M., et al., *Intraocular pressure variation during weight lifting*. *Arch Ophthalmol*, 2006. **124**(9): p. 1251-4.
  7. Bakke, E.F., J. Hisdal, and S.O. Semb, *Intraocular pressure increases in parallel with systemic blood pressure during isometric exercise*. *Invest Ophthalmol Vis Sci*, 2009. **50**(2): p. 760-4.
  8. Conte, M., et al., [*Intraocular pressure variation after submaximal strength test in resistance training*]. *Arq Bras Oftalmol*, 2009. **72**(3): p. 351-4.
  9. Risner, D., et al., *Effects of exercise on intraocular pressure and ocular blood flow: a review*. *J Glaucoma*, 2009. **18**(6): p. 429-36.
  10. Price, E.L., et al., *Effect of exercise on intraocular pressure and pulsatile ocular blood flow in a young normal population*. *Optom Vis Sci*, 2003. **80**(6): p. 460-6.
  11. Lovasik, J.V. and H. Kergoat, *Consequences of an increase in the ocular perfusion pressure on the pulsatile ocular blood flow*. *Optom Vis Sci*, 2004. **81**(9): p. 692-8.
  12. Harris, A., et al., *Isocapnia blocks exercise-induced reductions in ocular tension*. *Invest Ophthalmol Vis Sci*, 1992. **33**(7): p. 2229-32.
  13. Wiley, R.L. and A.R. Lind, *Respiratory responses to sustained static muscular contractions in humans*. *Clin Sci*, 1971. **40**(3): p. 221-34.
  14. Poole, D.C., S.A. Ward, and B.J. Whipp, *Control of blood-gas and acid-base status during isometric exercise in humans*. *J Physiol*, 1988. **396**: p. 365-77.
  15. Imms, F.J. and D. Mehta, *Respiratory responses to sustained isometric muscle contractions in man: the effect of muscle mass*. *J Physiol*, 1989. **419**: p. 1-14.
  16. Prajina P. and Sheila.R, *Variations in intraocular pressure during different phases of menstrual cycle among indian population*. 2004. **17**: p. 86-89.
  17. Gupta, P.D., et al., *Sex hormone receptors in the human eye*. *Surv Ophthalmol*, 2005. **50**(3): p. 274-84.
  18. Passo, M.S., D.L. Elliot, and L. Goldberg, *Long-term effects of exercise conditioning on intraocular pressure in glaucoma suspects*. *J Glaucoma*, 1992. **1**(1): p. 39-41.