

Morphological study of human cataract lens nuclei

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Abstract

Background: Every aging person develops morphologic lens changes. Along with these changes there is gradual loss of transparency leading to formation cataract. In this study we have tried to study these morphological changes in extracted cataractous lens nuclei. **Aim:** study relation between increasing age and morphological parameters of human cataractous lens nuclei. **Materials and methods:** About 350 cataractous lens nuclei removed by extracapsular extraction method were collected and stored in 10% formalin. Only those nuclei having uniform shape and size were included in the study. Diameter and thickness of lens nuclei were measured with Vernier calliper. Weight is measured with two pan scientific balance. Detailed case history was recorded prior to surgery and correlated with morphological findings. Statistical analysis was performed. **Results:** Our study found that mean diameter for men was 6.61 mm and for women was 6.48 mm. Mean central thickness for men was 3.35 mm and for women was 3.33 mm. Mean wet weight for men was 82.49 mg and for women was 79.18 mg. We found statistically significant correlation between increasing age and diameter, thickness and weight of lens nuclei when unpaired 't' test of statistical significance was used. **Discussion:** Our study found that diameter, thickness and weight of lens nuclei show steady increase with increasing age. Our results are compared with other workers. **Conclusion:** Knowledge of these morphological parameters will help in employing suitable technique during phacoemulsification as well as extracapsular extraction.

Key Words: cataract, diameter, lens, thickness, weight

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INTRODUCTION

The lens is a transparent, biconvex flexible body that intervenes between the iris in front and the vitreous body behind. It is circular in outline. It presents anterior and posterior surfaces separated by rounded border, the equator. The central points of both surfaces are called anterior and posterior poles respectively. The line joining the two poles is called the axis of lens. The lens is devoid

of blood supply or nerve supply and obtains nutrition by diffusion from the aqueous and vitreous humour. It is entirely surrounded by capsule. Just beneath the anterior capsule there is a single layer of epithelial cells. The innermost central part of lens is called nucleus and outer part cortex. The normal diameter of lens at birth is 6.5 mm which progresses to 9 mm at 15 yrs and continue to grow beyond while its axial dimensions increase from 3.5 mm-4 mm at birth to 4.5-5mm at 95 yrs. Opacification of the lens of the eye which makes it blind is called cataract. Lens extraction is indicated when visual impairment interferes with the patients normal activities. It is estimated that in India, about 4 million new cataract cases are diagnosed annually and cataract surgery is the most common operation performed on patients over 65 years of age. In extracapsular cataract extraction, lens capsule is left behind for implanting the intraocular lens and the opacified lens nucleus and part of cortex surrounding it are removed. Every aging person develops morphological lens changes. In this study we have tried to find the

relation between increasing age and increase in the morphological parameters of these cataractous lens nuclei extracted from the patients residing in a rural area like Marathwada region. The findings are supported with detailed case history and statistical analysis.

MATERIALS and METHODS

About 350 cataractous human lens nuclei belonging to patients coming from remote rural parts of Marathwada region were collected from the ophthalmic operation theatre of Swami Ramanand Teerth Rural Medical College, Ambajogai; during routine operations and also during various camps organized by the Department of Ophthalmology. The lens nuclei were collected in plain bulbs and preserved in 10% formalin for morphological observations.¹ Detailed case history of the patient undergoing extracapsular cataract extraction is recorded.

OBSERVATIONS

The data obtained from the case history of the 350 patients is compared with values of the morphological parameters of these nuclei and are tabulated as follows.

Table 1: Distribution of cases according to age and sex

Age group	No of cases		Percentage
	Male	Female	
36-40	3	2	1.43
41-45	9	--	2.57
46-50	7	4	3.14
51-55	13	10	6.57
56-60	29	32	17.43
61-65	35	40	21.43
66-70	41	45	24.57
71-75	12	20	9.14
76-80	12	17	8.29
81-85	8	11	5.43
Total	169	181	100

Table no 1 shows that among the total 350 cases included in this study, there were 169 male (48.29 %) and 181 female cases (51.71 %) with female having a little higher percentage. It also shows the distribution of all cases according to age group and the percentage of cases in each age group. Maximum cases are between 60 to 70 years.

Table 2: Showing mean diameters of different age groups of lens nuclei

Age group	Male		Female	
	Diameter	±S.D.	Diameter	±S.D.
36-40	4.96	0.16	5.4	0.84
41-45	5.13	0.31	--	--
46-50	5.54	0.56	5.03	0.11
51-55	5.62	0.69	5.16	0.37
56-60	5.96	0.92	5.99	0.96
61-65	6.25	1.04	6.20	0.93
66-70	7.40	0.81	6.57	1.09
71-75	7.74	0.57	7.36	0.73
76-80	7.77	0.50	7.40	0.49
81-85	7.87	0.54	7.45	0.54
Mean	6.61	1.19	6.48	1.09

Table 3: Showing mean central thicknesses (mm) of age groups of human lens nuclei

Age group	Male		Female	
	Thickness	+S.D.	Thickness	+S.D.
36-40	2.63	0.05	2.85	0.35
41-45	2.76	0.21	--	--
46-50	2.95	0.29	2.67	0.09
51-55	2.93	0.36	2.80	0.21
56-60	3.10	0.39	3.15	0.38
61-65	3.22	0.45	3.24	0.37
66-70	3.65	0.23	3.36	0.41
71-75	3.78	0.10	3.66	0.24
76-80	3.78	0.10	3.68	0.13
81-85	3.81	0.12	3.71	0.14
Mean	3.35	0.46	3.33	0.42

These observations show that the diameter and thickness of the lens nuclei go on increasing as the age advances. But when the 't' test of statistical significance is applied to each parameter of successive age groups, the t values are statistically insignificant. When the unpaired 't' test of statistical significance is used for values of first and last group the t values are statistically significant. These are as follows: for Mean diameter - ($P < 0.05$) for both male and female; for mean thickness - ($P < 0.05$) for male and ($P < 0.001$) for female. Mean diameter for male is little higher than female but statistically insignificant. The Mean diameter for all cases is 6.55 ± 1.14 mm. Mean thickness for male is little higher than female but statistically insignificant. The unpaired 't' test of statistical significance is used. Mean thickness for all cases is 3.34 ± 0.45 mm.

Table 4: Showing mean wet weights (mg) of different age groups of lens nuclei

Age group	Male		Female	
	Wet weight	+S.D.	Wet weight	+S.D.
36-40	65.00	1.00	68.50	9.19
41-45	66.44	4.61	--	--
46-50	71.28	7.43	64.00	0.81
51-55	72.76	8.58	66.90	4.14
56-60	76.27	9.56	74.71	9.85
61-65	78.88	11.52	76.47	8.94
66-70	90.63	7.42	79.88	10.96
71-75	94.16	5.37	87.85	6.91
76-80	93.66	5.08	87.94	5.44
81-85	95.12	5.24	88.54	5.39
Mean	82.49	12.32	79.18	10.72

The weights of the nuclei are also compared according to age groups. The values show definite increase with age but statistically insignificant. Values for the two extreme age groups when compared, show statistically significant increase ($P < 0.01$) for male and ($P < 0.05$) for female. Mean value of wet weight for all cases is 80.78 ± 11.62 . Values for weights between male and female are statistically insignificant.

**Photograph 1:** showing Vernier calliper with a few lens nuclei

DISCUSSION

The pathogenesis of cataract is multifactorial involving complex interactions between various physiologic processes. These interactions lead to changes in normal morphology of beautiful transparent lens which gradually loses its transparency leading to advancement of cataract. We have made an attempt to study these changes in the extracted lens nuclei. Our study has patients from 36yr to 85 yrs of age. However maximum (45%) patients are found in 60-70 yrs of age. When diameter, thickness and weight of extracted lens nuclei are measured they show definite increase as the patient ages. However this increase is gradual and statistically significant only when first and last age groups are compared.

Table 5: comparison of age groups and mean diameter

Age group	Mean diameter (mm)				
	Dorairaj S J ⁴		Present study		Gullapalli ⁵
	Min	Max	Min	Max	Mean
35-39	4.5	8	4.8	6	--
40-49	5	9	4.85	6.3	7.23
50-59	7	9	4.8	7.45	7.01
60-69	7	9	4.85	8.45	7.08
70-79	8	9	4.85	8.5	7.24
80 and above	8	9	7	8.5	7.11-7.75

In the present study, we found that diameter of the lens nucleus goes on increasing as age advances. This increase is also noted by Dorairaj S. J.⁴, Gullapalli *et al*⁵ and A. Glasser *et al*.^{6,7} Values for mean diameter of lens nucleus found in present study nearly correlate with those of the above workers.

Table 6: comparison of age groups and mean thickness

Age group	Mean central thickness (mm)				
	Dorairaj S J ⁴		Present study		Gullapalli ⁵
	Min	Max	Min	Max	Mean
35-39	3	4	2.6	3.1	--
40-49	3.5	3.5	2.6	3.3	3.03
50-59	3	5	2.7	3.7	2.98
60-69	3.5	5	2.7	3.9	3.00
70-79	4	5	2.8	3.9	3.15
80 and above	4.5	5	3.6	4	3.11-3.47

The present study found that thickness of lens nucleus goes on increasing as age advances. This finding of the present study correlates with those of Dorairaj S J *et al*⁴ and Gullapalli *et al*.⁵ Many studies have found that the overall lens thickness, thickness of nucleus and cortex goes on increasing with age.^{6,7,8} The mean diameter of the lens nucleus for the present study was found to be 6.55 ± 1.14 mm. Mean central thickness was found to be 3.34 ± 0.45 mm. Values found by other workers for diameter and thickness of lens nucleus are as follows –

Table 7: comparison of mean diameter and mean thickness values between other workers.

Study	Mean diameter (mm)	Mean thickness (mm)
Gullapalli <i>et al</i> ⁵ (1995)	7.13 ± 0.76	3.05 ± 0.48
Ayaki M <i>et al</i> ⁹ (Jul 1993)	6.51 ± 0.75	2.96 ± 0.33
Ayaki M <i>et al</i> ¹⁰ (Nov 1993)	6.43 ± 0.86	2.93 ± 0.36
Dorairaj, S J <i>et al</i> ⁴ (2002)	8.5 ± 0.15	4.50 ± 0.1
Present study	6.55 ± 1.14	3.34 ± 0.45

Present study has recorded a positive correlation between diameter and central thickness ($P < 0.05$) for increase in age. Ayaki M *et al*^{9,10} and Dorairaj S J⁴ have also found significant increase in diameter and central thickness for age ($P < 0.05$) while Gullapalli *et al*⁵ have found no significant correlation between these parameters and age. Our study has also found positive correlation between age of patient and wet weight of lens. We have measured extracted lens nuclei from cataract patients. These include the hardened central nucleus and part of softer outer cortex which surrounds it. However the lens capsule is left behind. So the dimensions we have measured are of lens nucleus and not of entire lens. Naturally it is more difficult to get entire lens for morphometric analysis than lens nuclei. Although clinically dimensions of lens nuclei will be more important than entire lens because it is the nucleus which is to be expressed out either during phacoemulsification of extracapsular extraction and not the entire lens.

CONCLUSION

The knowledge of these above parameters measured in present study would help in employment of suitable technique during cataract extraction especially that of central thickness and weight of nucleus would be useful in trenching of the nucleus during phacoemulsification.^{3,5,11} In routine cataract extraction, the knowledge of diameter and central thickness of lens nucleus would, in turn, indicate length of section required to express a particular nucleus. A slightly larger section would facilitate easy expression of nucleus. This would thereby reduce the use of very large section and consequently reduce degree of postoperative astigmatism.^{4,5,10,11}

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