

# COMPARISON OF INTRAOCULAR LENS IMPLANTATION WITH AND WITHOUT VISCOELASTIC SUBSTANCES IN PHACOEMULSIFICATION

By

**Hossam Mohamed Khalil Mohamed, Mohamed Zakaria Eid and Sayed  
Mustafa El-Sayed**

Department of Ophthalmology, Faculty of Medicine, Al-Azhar University

**Corresponding author:** Hossam Mohamed Khalil Mohamed,

**E-mail:** [hossamkhalil323@gmail.com](mailto:hossamkhalil323@gmail.com)

## ABSTRACT

**Background:** Life expectancy of the population may increase and cataract development may affect all the people with aging. Intraocular lens implantation surgery, a worldwide performed procedure, evolves and progresses. However, different techniques exist, which could be selected for different cases. Any ideal technique should be safe, simple, fast, and easy to learn with good clinical outcome.

**Objective:** The aim of this work was to compare the efficacy and safety of intraocular lens implantation with and without ophthalmic viscoelastic device after phacoemulsification as well as surgery duration and post-operative intraocular pressure and central corneal thickness.

**Patients and methods:** This was a prospective, randomized controlled trial conducted on 40 eyes with cataract; to compare the efficacy and safety of intraocular lens implantation with and without ophthalmic viscoelastic device after phacoemulsification of the lens as regard to surgery duration, post-operative intraocular pressure and central corneal thickness. Patients were evaluated 1 day, 1 week, and 1 month postoperatively. Patients were divided into two groups after the completion of lens cortex removal: Group A (n=20, hydro-implantation): One-piece acrylic intraocular lens implantation was performed with normal saline solution (0.9 solution) irrigation. Group B (n=20, visco-implantation): using Hydroxy-propyl-methyl-cellulose 2% implantation.

**Results:** Highly significant increase in phaco operative time in visco-implantation group; compared to hydro-implantation group ( $p < 0.0001$ ), Non-Significant increase in post-operative IOP, in visco-implantation group; compared to hydro-implantation group ( $p > 0.05$  respectively). Non-significant difference as regards post-operative Central corneal thickness (CCT) ( $p > 0.05$ ). Non-significant increase in post-operative CCT measurements in visco-implantation group ( $p > 0.05$ ). Non-significant difference in post-operative IOP measurements in visco-implantation group ( $p > 0.05$ ). Non-significant decrease in post-operative IOP and CCT measurements in hydro-implantation group ( $p > 0.05$ ). Non-significant decrease in post-operative IOP in hydro-implantation group; compared to visco-implantation group; during the serial 1st and 2nd measurements. Non-significant increase in post-operative CCT in Visco-implantation group; compared to hydro-implantation group; during the serial 1st and 2nd measurements.

**Conclusion:** The hydro-implantation had similar clinical outcome to visco-implantation with advantage of reduced surgical time and cost, and no ophthalmic viscosurgical devices (OVD) induced intraocular pressure elevation postoperatively.

**Keywords:** Intraocular lens implantation, Viscoelastic substances, Phacoemulsification.

## INTRODUCTION

An ophthalmic viscosurgical device (OVD) used to maintain anterior chamber space and prevent damage to intraocular tissue during cataract surgery excellent for protection of corneal endothelial cells (YOON *et al.*, 2019). However, residual OVD in the anterior chamber (AC) may cause postoperative adverse effects and needs to be completely removed at the end of surgery (Bardoloi *et al.*, 2020) some cataract surgeons have preferred the hydroimplantation technique of intraocular lens implantation without OVDs (Studený *et al.*, 2014).

Tak (2010) was the first to describe the hydro implantation technique. In this technique, intraocular lens implantation was performed under continuous balanced salt solution irrigation without OVDs.

Other studies in literature reported safety of hydro implantation technique (Oğurel *et al.*, 2017 and Ozates *et al.*, 2017).

**The aim of this work was to** compare the efficacy and safety of intraocular lens implantation with and without ophthalmic viscoelastic device after phacoemulsification as well as surgery duration and post-operative intraocular pressure and central corneal thickness.

## PATIENTS AND METHODS

This was a prospective, randomized controlled trial conducted on 40 eyes with cataract. Patients were evaluated 1 day, 1 week, and 1 month postoperatively.

**Ethical considerations:** All participant names were hidden & replaced by code numbers to maintain privacy of the patients. An informed consent was

obtained from all participants before the study.

**Inclusion criteria:** Clinically significant cataract with moderate density according to new soft wear Pentacam Nuclear grading System (PNS).(N1-N2)

### Exclusion criteria:

1. Patients having complicated cataract.
2. Previous ocular surgery, laser procedure or trauma.
3. Small pupil, shallow anterior chamber, hard cataract (N3-N4).
4. Coexisting ocular disorders (corneal disorder, glaucoma, pseudoexfoliation, uveitis, and retinal disorder).

### Patients were divided into two groups after the completion of lens cortex removal:

- **Group A (n=20, hydro-implantation):** One-piece acrylic intraocular lens implantation was performed with normal saline solution (0.9% solution) irrigation.
- **Group B (n=20, visco-implantation):** using Hydroxy-propyl-methyl-cellulose 2% implantation.

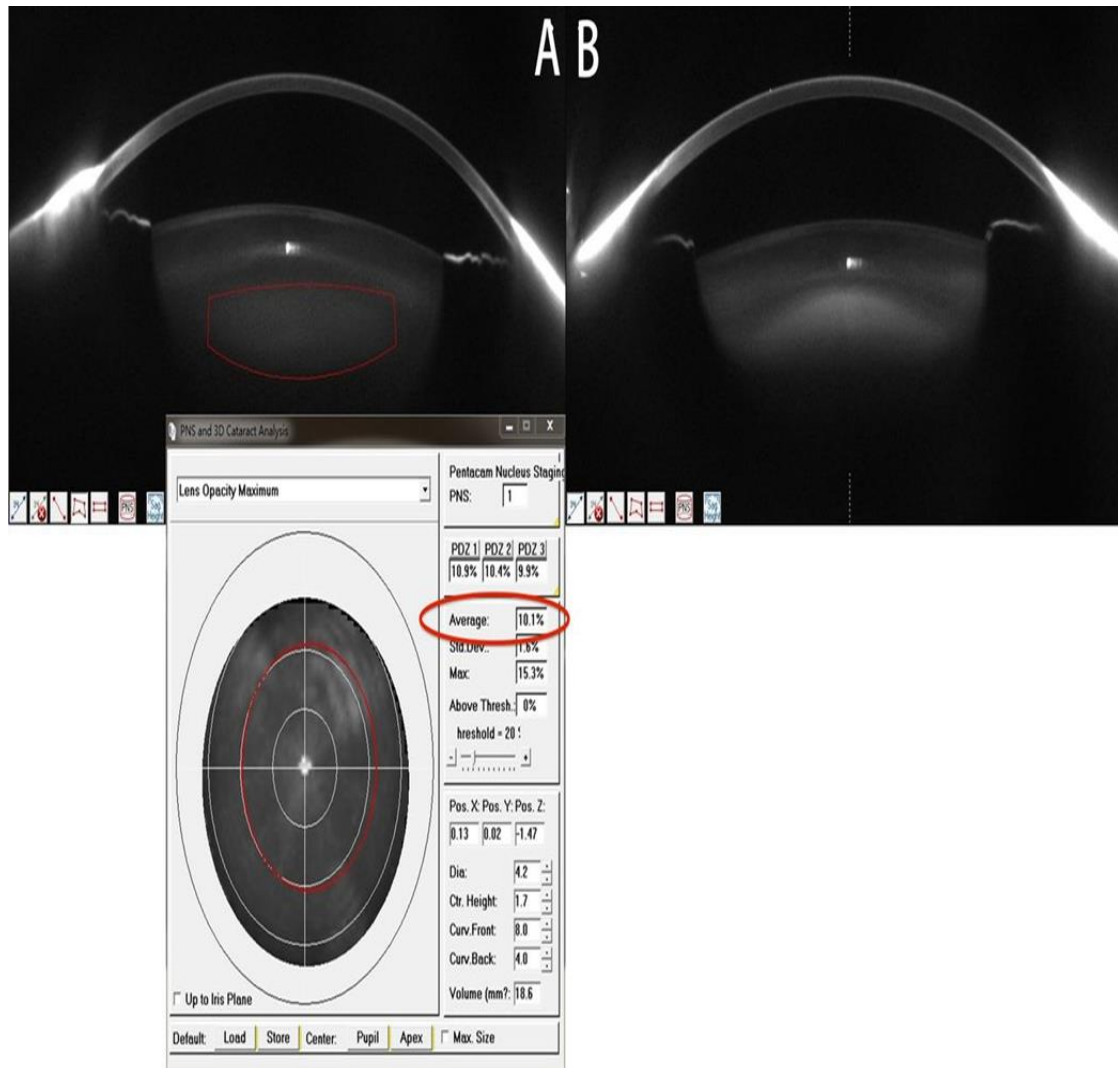
### All patients were subjected to:

1. All the study participants were undergoing detailed clinical, ophthalmologic examinations including best-corrected visual acuity.
2. Measurements of IOP (using the goldmann's applanation tonometry).
3. Slit-lamp bio-microscopy.
4. Degree of lens opacification was graded by pentacam nuclear staging (**Figure 1**) (Pei *et al.*, 2008).

5. Measurements of central corneal thickness (CCT) were performed

before and after the surgery.

6. Surgery time was recorded.



**Figure (1): Degree of lens opacification was graded by pentacam nuclear staging**

#### **Post-operative follow-up:**

1. Patients were evaluated 1 day, 1 week, and 1 month postoperatively.
2. All patients were undergoing routine ophthalmic examination at every follow-up visit including mainly visual acuity, intraocular pressure and CCT was measured with Pentacam.

#### **Statistical Methodology:**

Data entry, processing and statistical analysis was carried out using MedCalc ver. 18.11.3 (MedCalc, Ostend, Belgium). Descriptive statistics: Mean, Standard deviation ( $\pm$  SD) for parametric numerical data, while Median and Inter-quartile range (IQR) for non-parametric numerical data. Frequency and percentage of non-numerical data.

**Analytical statistics:** Mann-Whitney's Test (U test) was used to assess the statistical significance of the difference of a non-parametric variable between two study groups. Wilcoxon's test was used to assess the statistical significance of the

difference of a non-parametric variable between two (paired) study group means. The ROC Curve (receiver operating characteristic) provides a useful way to evaluate the Sensitivity and specificity.

## RESULTS

The mean age of all patients was  $58.1 \pm 6.46$  years. Regarding gender of the

patients, 52.5% of patients were females; while 47.5% were males (**Table 1**).

**Table (1): Socio-demographic data among 40 eyes**

Variables		Frequency (%)
Age (years)		$58.1 \pm 6.46^*$
Gender	Female	21 (52.5%)
	Male	19 (47.5%)

\* Mean  $\pm$  SD.

Regarding pre and post-operative data, the average IOP of all patients was ( $17.47 \pm 2.35$ ) mmHg; the average CCT was ( $587.7 \pm 55.8$ )  $\mu\text{m}$ , while the average phaco operative time was ( $14.7 \pm 1.8$ )

min. Regarding post-operative outcome data, the average IOP of all patients was ( $14.7 \pm 2.46$ ) mmHg; and the average CCT was ( $592.37 \pm 59.2$ )  $\mu\text{m}$  (**Table 2**).

**Table (2): Pre and post -operative data among 40 eyes**

Variables	Pre	Post
	Mean $\pm$ SD	Mean $\pm$ SD
IOP (mmHg)	$17.47 \pm 2.35$	$14.7 \pm 2.46$
CCT ( $\mu\text{m}$ )	$587.7 \pm 55.8$	$592.37 \pm 59.2$
Phaco operative time (min)	$14.7 \pm 1.8$	-

IOP: Intra-ocular pressure. CCT: Central corneal thickness.

Comparative study between the 2 groups revealed significant increase in phaco operative time in Visco-implantation group; compared to Hydro-implantation group. Comparative study between the 2 groups revealed non-significant difference as regards pre-operative IOP and CCT. Comparative

study between the 2 groups revealed Non-significant increase in post-operative IOP, in Visco-implantation group compared to Hydro-implantation group. Comparative study between the 2 groups revealed non-significant difference as regards post-operative CCT (**Table 3**).

**Table (3): Comparison between the 2 groups as regards pre and post-operative data using Mann-Whitney's U test**

Parameters		Groups	Hydro-implantation Group (20)	Visco-implantation Group (20)	Mann-Whitney's U test
			Median (IQR)	Median (IQR)	P value
Pre	IOP (mmHg)		17.5 (16 – 19)	17 (15 – 19)	= 0.4514
	CCT (µm)		591 (538 – 616)	593 (538 – 630)	= 0.4138
	Phaco operative time (min)		13.5 (12.3 – 14.2)	16.1 (15.1 – 16.7)	< 0.0001**
Post	IOP (mmHg)		16 (14 – 17)	16 (15 – 19)	= 0.1388
	CCT (µm)		587.5 (542.5 – 616)	592.5 (539 – 636)	= 1.000

Comparative study between pre and post-operative measurements revealed Non-significant increase in post-operative CCT measurements in Visco-implantation group. Comparative study between pre and post-operative measurements revealed; non-significant difference in

post-operative IOP measurements in Visco-implantation group. Comparative study between pre and post-operative measurements revealed; non-significant decrease in post-operative IOP and CCT measurements in Hydro-implantation (Table 4).

**Table (4): Comparison between Visco-implantation and Hydro-implantation patients as regards serial pre and post-operative assessments**

Parameters		Assessment	Pre-operative measurement	Post-operative measurement	Wilcoxon's test
			Median (IQR)	Median (IQR)	P value
Visco-implantation	IOP (mmHg)		17 (15 – 19)	16 (15 – 19)	= 1.000
	CCT (µm)		593 (538 – 630)	592.5 (539 – 636)	= 0.8983
Hydro-implantation	IOP (mmHg)		17.5 (16 – 19)	17.5 (16 – 18.5)	= 0.1465
	CCT (µm)		591 (538 – 616)	587.5(542.5–616)	= 0.2943

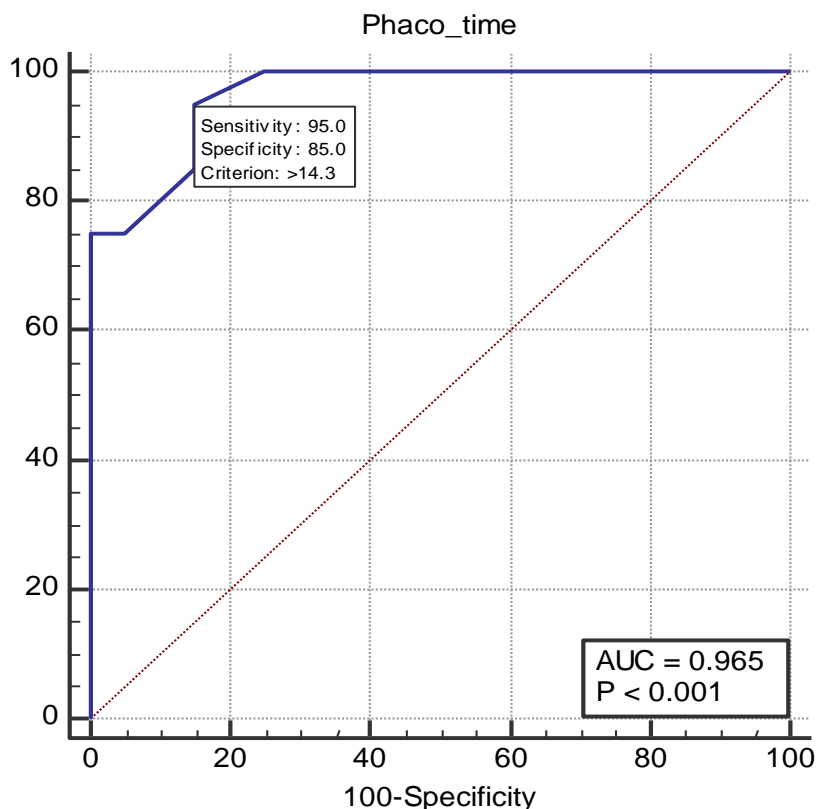
By using ROC-curve analysis, Visco-implantation usage predicted patient's short Phaco time, with excellent (96%) accuracy, sensitivity= 95% and specificity= 85% (p < 0.001).

By using ROC-curve analysis, Visco-implantation usage showed non-significant predictive values in patient's post-operative IOP and CCT improvement (p > 0.05) (Table 5 and Fig 2 ).

**Table (5): Roc-curve of Visco-implantation usage to predict patient's post-operative improvement**

Variables	AUC	SE	Sensitivity (%)	Specificity (%)	P value
Post-operative IOP	0.561	0.0937	55	65	0.5132
Post-operative CCT	0.500	0.0932	60	30	1.000

ROC (Receiver operating characteristic), AUC= Area under curve, SE= Standard Error.



**Figure (2) : ROC curve of post-operative Phaco time**

## DISCUSSION

We found that; the mean age of all patients was ( $58.1 \pm 6.46$ ) years. Regarding gender of the patients, (52.5%) of patients were females; while (47.5%) were males. which came in agreement with *Unsal, et al. (2017)*, *Taşkın & Aslan (2018)* and *Bardoloi et al. (2020)*.

Comparative study between the 2 groups revealed non-significant difference as regards pre-operative IOP and CCT, which came in agreement with *Taşkın and Aslan (2018)*.

*Taşkın and Aslan (2018)* reported that, the mean preoperative IOP in Group 1 and Group 2 was  $15.7 \pm 3.5$  and  $15.3 \pm 4.2$  mmHg, respectively. The differences of the mean preoperative IOP and CCT

measurements of the groups were not statistically significant

Comparative study between the 2 groups revealed; non-significant increase in post-operative IOP, in Visco-implantation group; compared to Hydro-implantation group, which came in agreement with *Taşkın and Aslan (2018)* who reported that, the use of OVDs did not have a significant effect on IOP in our cases, since we removed these devices completely through the anterior chamber and from the back of IOL.

Comparative study between the 2 groups revealed non-significant difference as regards post-operative CCT. Pre and post-operative measurements revealed non-significant increase in post-operative CCT measurements in Visco-implantation

group, which came in agreement with *Kamiya et al. (2011)* who reported that the variance of the data was not statistically significant. Multiple comparisons showed no significant differences between preoperative measurements and postoperative measurements at 1 day 1 week, 1 month or 3 months.

Comparative study between pre and post-operative measurements revealed non-significant difference in post-operative IOP measurements in Visco-implantation group as we washed OVD well after implantation, which came in agreement with *Taşkın and Aslan (2018)* who reported that, the use of OVDs did not have a significant effect on IOP in our cases, since we removed these devices completely through the anterior chamber and from the back of IOL.

## CONCLUSION

The hydro-implantation had similar clinical outcome to visco-implantation with advantage of reduced surgical time and cost and no OVD-induced intraocular pressure elevation postoperatively.

## REFERENCES

1. **Bardoloi N, Sandip S, Ashu P and Himangshu D (2020):** Pure Phaco: Phacoemulsification without Ophthalmic Viscosurgical Devices. *Journal of Cataract & Refractive Surgery*, 46(2): 174–178.
2. **Kamiya K, Kimiya S, Fumiko O and Rie A (2011):** Evaluation of Corneal Biomechanical Parameters after Simultaneous Phacoemulsification with Intraocular Lens Implantation and Limbal Relaxing Incisions. *Journal of Cataract & Refractive Surgery*, 37(2): 265–270.
3. **Oğurel, T., Oğurel, R., Onaran, Z. and Örnek, K., (2017):** Safety of hydro-implantation in cataract surgery in patients with pseudo exfoliation syndrome. *International Journal of Ophthalmology*, 10(5): 723-756.
4. **Ozates, S., Koc, M., Uzel, M.M. and Yilmazbas, P., (2017):** Comparison of intraocular lens position change following two different implantation techniques. *Current Eye Research*, 42(9):1235-1239.
5. **Pei X., Yongzhen B., Yi C. and Xiaoxin L. (2008):** Correlation of Lens Density Measured Using Pentacam Scheimpflug System with LOCS III Grading Score and Visual Acuity in Age-Related Nuclear Cataract. *British Journal of Ophthalmology*.
6. **Studeny, P., Hyndrak, M., Kacerovsky, M., Mojzis, P., Sivekova, D. and Kuchynka, P. (2014):** Safety of hydroimplantation: a foldable intraocular lens implantation without the use of an ophthalmic viscosurgical device. *European Journal of Ophthalmology*, 24(6): 850-856.
7. **Tak H. (2010):** Hydroimplantation: foldable intraocular lens implantation without an ophthalmic viscosurgical device. *Journal of Cataract & Refractive Surgery*, 36(3): 377-379.
8. **Taşkın I and Aslan L. (2018):** Effects of Phacoemulsification with versus without Viscoelastic Devices on Surgical Outcomes. *International Ophthalmology*, 38 (1): 5–10.
9. **Unsal, Ugur, Gonen B., and Mehmet S. (2017):** “Intraocular Lens Implantation without the Use of Ophthalmic Viscosurgical Device.” *International Ophthalmology* 37 (1): 25–30.
10. **Yoon, Do Y, Joo H K , Hyun S J, Hee E J, Sang B H, and Joon Y H.(2019):** “Evaluation of the Protective Effect of an Ophthalmic Viscosurgical Device on the Ocular Surface in Dry Eye Patients during Cataract Surgery.” *Korean Journal of Ophthalmology* 33 (5): 467-468.

## مقارنة بين زرع العدسة داخل العين مع وبدون مواد مرنة لزجة بعد إستحلاب العدسة

حسام محمد خليل محمد، محمد زكريا عيد، سيد مصطفى السيد

قسم طب وجراحة العيون، كلية الطب، جامعة الأزهر

E-mail: [hossamkhalil323@gmail.com](mailto:hossamkhalil323@gmail.com)

**خلفية البحث:** احتمال زيادة متوسط العمر المتوقع للسكان قد يزيد من وجود إعتام عدسة العين على معظم الأشخاص مع تقدم العمر. تتطور وتتطور جراحة زرع العدسة داخل العين، وهي إجراء يتم إجراؤه في جميع أنحاء العالم. ومع ذلك، توجد تقنيات مختلفة، والتي يمكن اختيارها لحالات مختلفة. والتقنية المثالية آمنة وبسيطة وسريعة وسهلة التعلم مع نتائج سريرية جيدة.

**الهدف من البحث:** مقارنة فعالية وسلامة زراعة العدسة داخل العين مع وبدون مواد اللزوجة المرنة للعين بعد استحلاب العدسة فيما يتعلق بمدة الجراحة وضغط العين بعد الجراحة وسماكة القرنية المركزية.

**المرضي وطرق البحث:** كانت هذ تجربة عشوائية مستقبالية ذات شواهد أجريت على 40 عيناً مصابة بإعتام عدسة العين. لمقارنة فعالية وسلامة زرع العدسة داخل العين مع وبدون مواد اللزوجة المرنة للعين بعد استحلاب العدسة من حيث مدة الجراحة وضغط العين بعد الجراحة وسماكة القرنية المركزية.

**نتائج البحث:** زيادة ملحوظة في وقت إجراء جراحات العدسة في مجموعة زرع اللزوجة ( $p < 0.0001$ ). زيادة غير مهمة في ضغط العين بعد الجراحة، في مجموعة اللزوجة؛ مقارنة بمجموعة الغرس المائي. فرق غير مهم فيما يتعلق بسماك القرنية بعد الجراحة ( $p > 0.05$ ). زيادة غير مهمة في قياسات سمك القرنية بعد الجراحة في مجموعة اللزوجة ( $p > 0.05$ ). فرق غير مهم في قياسات ضغط العين بعد الجراحة في مجموعة



اللزوجة ( $p > 0.05$ ) انخفاض غير مهم في قياسات ضغط العين و سمك القرنية بعد الجراحة في مجموعة الزرع المائي ( $p > 0.05$ ). انخفاض غير مهم في ضغط العين بعد الجراحة في مجموعة الزرع المائي. مقارنة بمجموعة اللزوجة؛ خلال قياسات الأول والثاني. زيادة غير مهمه في سمك القرنية بعد الجراحة في مجموعة اللزوجة؛ مقارنة بمجموعة الغرس المائي؛ خلال قياسات الأول والثاني. يوضح تحليل ارتباط سبيرمان ذلك؛ كان لدى ضغط العين قبل الجراحة علاقة إيجابية مع ضغط العين بعد الجراحة.

**الاستنتاج:** كانت النتائج السريرية للزرع المائي مماثلة لزرع اللزوجة بل افضل من حيث تقليل الوقت و تكلفة الجراحه و عدم ارتفاع ضغط العين الناجم عن مواد اللزوجة بعد الجراحة.

**الكلمات الدالة:** زرع عدسة داخل العين، مواد لزجة مرنة، إستحلاب العدسة.