An Efficient Method to Alter the Drop Volume of Topical Ophthalmic Medications
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Methods

This study incorporated the utility of commercially available 15 mL low density polyethylene (LDPE) bottles with a curve from the bottle reservoir through the neck allowing smooth flow configured with a Luer lock cap. The bottle was configured with four 0.5 inch and one 1.5 inch long Luer lock flexible polypropylene dispensing tips of 0.250, 0.840 and 1.370 mm inside diameter bore size (Figure 1).

The mean drop volume for each tip size was determined by densitometric methodology using sterile water as the test article. An analytical balance with readability to 0.1mg was employed for determination of drop mass. An LDPE bottle was fitted with each dispensing tip, and then the bottle held at 90 degrees from the horizontal. Ten drops were administered into a plastic specimen dish and the mass calculated. This process was subsequently repeated so that 8-14 mass measurements were obtained, each for a set of ten drops.

The volume of each drop was determined by dividing each set of drops by ten (the number of drops dispensed) to determine the average mass which was then divided by the density of sterile water, 994.0 mg/ml. Coefficient of variation in drop volume ranged from 3.96-5.57%. A one way analysis of variance (ANOVA) demonstrated a statistically significant difference between mean drop volumes (p <0.0001). Tukey multiple comparisons post-test showed a statistically significant difference in all paired groupings with the exception of the 0.5 and 1.5” 0.250 mm bore size categories.

Results

Drop volume measured for each experimental set is demonstrated on Graph 1. Mean drop volume for the 0.5” tips of 0.250, 0.840 and 1.370 mm bore size was 11.34, 18.39 and 28.15 µL respectively (Graph 2). Mean drop volume for the 1.5” 0.250 mm bore needle was 11.22 µL. Coefficient of variation in drop volume ranged from 3.96-5.57%. A one way analysis of variance (ANOVA) demonstrated a statistically significant difference between mean drop volumes (p <0.0001).

Conclusion

Topical ophthalmic drop volume can be modifiable in a reliable and precise manner through use of a novel Luer lock tip-bottle combination system. The system can provide desired flexibility in dosing topical ophthalmic medication simply through changes in the bore of the delivery tip. Further study will examine the safety and efficacy of such a system in vivo through dose-response measurements.

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References


Figure 1:

Top: 1.5” 0.250 mm bore dispenser
Middle: 0.5” 0.840 mm bore dispenser
Bottom: 0.5” 0.840 mm bore dispenser with Luer lock cap affixed to a commercially available 0.5 oz artificial tear bottle.

All tips are composed of flexible polypropylene.