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ORIGINAL COMMUNICATION

Use of a pupillometer to assess change in pupillary size post-cannabis

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INTRODUCTION

Reported ocular effects of cannabis include abnormalities of eye movements and effects on pupil size and reaction to a light stimulus.[1] However the effect of cannabis on pupil size is controversial. Hepler[2] examined the pupils before smoking (2 g of cannabis in a 30 min period using an ice-cooled pipe with a tetrahydrocannabinol (THC) concentration 1.5%) and at intervals of 5, 60, 150 and 300 min after smoking and demonstrated that the pupils tend to constrict slightly soon after smoking cannabis. Green[3] has stated that pupillary dilation is often erroneously attributed to cannabis and suggests that this response is usually noted by law enforcement personnel and is more likely a product of fear. Certainly a report[4] with guidelines for doctors on the physical findings following cannabis states that the pupil size may be normal or dilated.

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In another study where 12 healthy volunteers inhaled a joint containing 40 mg THC within 10 min[5] pupil size was measured before dosing as well as at 40 and 80 min. The pupil diameter tended to decrease during THC impairment. Other research has shown that after a dose of 3.9% THC the pupil diameter decreased in size with a peak response at 30 min.[6]

PARTICIPANTS, METHOD AND RESULTS

This research was performed as part of a larger study on the effects of cannabis on driving the full report of which has been published.[7] Participants were males over 18 years of age who used cannabis at least once a week recruited via a "snowball" sampling technique. Participants were given four different cannabis doses. The first three were pre-prepared "grass" based cannabis cigarettes supplied by NIDA – placebo, low dose and high dose. The fourth was prepared from cannabis resin. Participants smoked a single cigarette on each visit. The maximum dose for low THC was on average about 11.5 mg, for high THC it was about 18 mg, and for resin the maximum dose was about 4.7 mg.

Pupillary size was measured using a Procyon Pupillometer Model P2000SA pre-dosing and at 30 min post-dosing. The researchers found the Pupillometer easy to use and the participants were seated in front of the Pupillometer at such a height to look into the eyepieces at a comfortable viewing angle. Ten images of the each pupil were then taken over a two second period to calculate the pupil size. The pupil size was also measured during sobriety testing using a reference card.

Table 1 Increase in pupil sizes by dose

		Sample size	Mean difference in pupil size	SD	SE	95% Confidence interval for mean	
						Lower bound	Upper bound
Right eye (mm)	Placebo	14	0.041	0.268	0.072	−0.113	0.194
	Low	14	0.395	0.452	0.121	0.136	0.654
	High	14	0.240	0.287	0.077	0.076	0.404
	Resin	12	0.081	0.382	0.110	−0.156	0.318
Left eye (mm)	Placebo	14	−0.011	0.226	0.060	−0.141	0.118
	Low	14	0.394	0.482	0.129	0.118	0.671
	High	14	0.204	0.233	0.062	0.071	0.338
	Resin	12	−0.026	0.309	0.089	−0.217	0.165

Using the Pupillometer the average pupil size increased from the baseline measurement at 30 min at both low and high dose but was more significant with low dose (Table 1). The analysis of variance indicated that there were statistically significant differences between placebo and high dose and between placebo and low dose. These were significant for the right pupil (placebo v high: $F_{1,23} = 5.49$, $p < 0.05$, and placebo v low: $F_{1,23} = 12.0$, $p < 0.01$), and for the left pupil (placebo v high: $F_{1,23} = 5.49$, $p < 0.05$, and placebo v low: $F_{1,23} = 13.62$, $p < 0.01$). Fig. 1 shows the mean differences for the right pupil and the 95% confidence intervals by dose.

It is clear from Fig. 1 that, whilst there is a difference in the mean pupil size when participants had received the low dose of cannabis, there is considerable variation between participants under both the low dose and under the influence of resin. Oddly, this effect was not apparent with the high dose of cannabis. It is also interesting to note that the effect is most pronounced with the low dose, and so appears not to be dose related.

Clinically the medical practitioners measured pupil size approximately 15 min post-dosing and in the 14 cases where clinical comparisons were possible over placebo the following results were obtained:

High dose:
11 pupil size increased (2 decrease, 1 unchanged)
Low dose:
8 pupil size increased (3 decrease, 3 unchanged)
Resin (13 cases):
3 pupil size increased (6 decrease, 4 unchanged)

Direct comparisons of the pupil size between the Pupillometer findings and the clinical findings are not possible as the conditions of measurement were different.

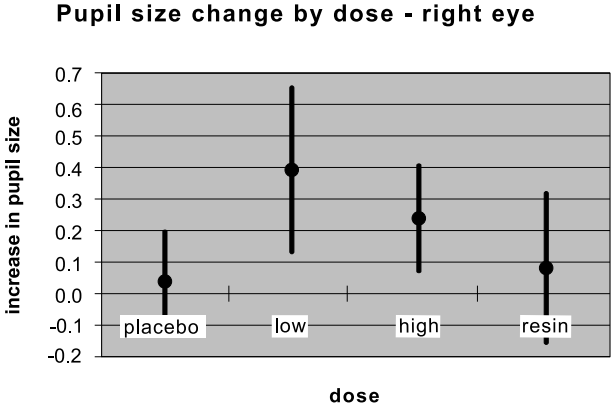

Fig. 1 Mean differences in pupil size by dose.

COMMENT

These findings, with the Pupillometer and clinically, of an increase in pupil size post-cannabis appear contradictory to previous research literature and require further evaluation.

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