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THE EFFECTS OF A REDUCED DRAW RESISTANCE CIGARETTE  
ON HUMAN SMOKING PARAMETERS AND ALVEOLAR CO LEVELS

RESTRICTED

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ABSTRACT

When smokers switched to a cigarette of 30% reduced draw resistance, an apparent increase in puff velocity resulted from puffs of shorter duration but of greater effort being taken. With a relative volume increase of less than 10%, the smokers significantly increased mouth nicotine intake by 56%. Although a similar increase in CO delivery would have been expected to be delivered to the mouth, the smokers were consistently noted to have alveolar resting CO levels 16% lower than with their normal cigarette. It is therefore apparent that the increased availability of nicotine to the smoker caused a decrease in the depth of inhalation. Rather surprisingly there appeared to be no adjustment in total daily cigarette consumption, butt length or puff number, as has been reported in other studies which have used these parameters as indicative of nicotine regulation.

It is felt that the alveolar resting levels of CO can be used as an indicator of depth of inhalation and, without such data, other smoking parameters may be most misleading.

The result of decreasing cigarette draw resistance, while maintaining nicotine delivery may be an effective means of reducing body CO levels; however the implications of such a cigarette design on delivery of other smoke components would require further study.

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INTRODUCTION

Numerous studies have been carried out investigating the changes in smoking habits when smokers were given cigarettes of higher and/or lower smoke delivery. These results indicate that smokers adjust the intensity (puff number, butt length, puffing effort, volume, duration) <sup>1,2</sup> with which they smoke, alter daily cigarette consumption <sup>3,4,5</sup> or vary the depth of inhalation <sup>6,7</sup> with the different smoking product. Each of these changed smoking parameters has been presented as evidence of a form of compensation to regulate body nicotine intake.

Since it is believed that a smoker may vary nicotine uptake by a factor of as much as 100 with either his normal smoking product or with one of totally different delivery depending solely on the depth of inhalation, <sup>8</sup> the changes noted for the more easily measurable smoking parameters mentioned above, may become meaningless relative to this inhalation factor. Questionnaires relating to the degree of inhalation are interesting <sup>9</sup>, but experience has proven that such results may be totally misleading when compared to CO analyses used to verify inhalation depths <sup>10</sup>.

In a previous communication from this laboratory <sup>6</sup> the technique of estimating CO concentrations in exhaled air was used on a limited number of smokers as an estimate of smoke inhalation. This work showed that when a nicotine enhanced cigarette was smoked, no nicotine regulation was apparent from butt nicotine data relative to the normal cigarette, but there was in

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fact a lesser degree of inhalation as evidenced by a significant decrease in lung CO concentrations in exhaled air. Although both cigarettes compared in the previously mentioned study had equivalent unlit draw resistance, the ease of availability of the added nicotine caused no change in the maximum puffing efforts of the smokers to obtain a satisfying mouthful of smoke.

A recent study using cigarette smoking baboons <sup>11</sup> has suggested that a low draw resistance cigarette allows for greater inhalation. Higher blood CO levels were found with the cigarette of lower draw resistance despite significantly fewer puffs having been taken from it. It was decided therefore to investigate the effects of cigarettes of equivalent nicotine delivery but of changed draw resistance on smoking parameters, mouth nicotine intake and alveolar CO levels of heavy cigarette smokers.

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SUBJECTS AND METHOD

Seven heavy smokers of a popular medium delivery cigarette available in Canada volunteered from the in-house staff to participate in this comparative study. Monitoring took place within the usual working environment such that normal smoking, aside from the addition of the mouth-piece could be followed. Laboratory personnel were not included in the study to avoid any possible prejudice by panel members. Smoking parameters and alveolar CO levels were monitored following the same techniques outlined previously <sup>6</sup>. It was only after acclimatization of the smoking instrumentation and the smoking products that smoking data were collected. Each smoker was monitored for smoking patterns and alveolar CO resting levels 3 times per day for 5 working days. Monitoring commenced after 10:30 a.m. such that each smoker had already smoked at least 6 cigarettes.

Alveolar air samples were collected not only before the smoking of each of the cigarettes monitored by the smoking instrumentation but also before each succeeding cigarette through the working day. Thus with this greater number of samples, a better estimate of daily resting CO levels could be ascertained. In addition the butts of these cigarettes smoked through the working day were collected for butt length and nicotine determination. In this way a better estimate of the changes in smoking habits, relative to these 2 parameters was available without the somewhat obtrusive monitoring instrumentation.

The physical parameters and smoke deliveries of the 2 brands compared in this study are listed in Table 1. The experimental cigarette was made with

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