

Devices Manipulating Eating Rate

Subjects: **Nutrition & Dietetics**

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Eating rate, as well as food texture and habitual characteristics, are considered important factors that affect an individual's food intake. A novel way of manipulating eating rate and thereby potentially decreasing energy intake is via the use of specially made devices and cutlery. The aforementioned slow eating rate by decreasing oral volume and bite size, by modifying their shape (vibrating or deflating) when eating rate is accelerated or by special recordings of eating events and eating speed and then training the subject to modify them.

eating rate

devices

1. Noninvasive Oral Devices

An oral device, custom-made for each individual, designed to decelerate eating rate by decreasing oral volume and bite size was studied in obese/overweight individuals in a 4-month open label trial (Figure 1) ^[1]. The device is placed in the upper palatal space and secured by metal clasps around the teeth before initiation of the meal and is removed after termination. Participants exhibited a 5.2% weight loss while using the aforementioned device accompanied by a hypocaloric diet. Participants reported eating slower even when the device was not used ^[1].

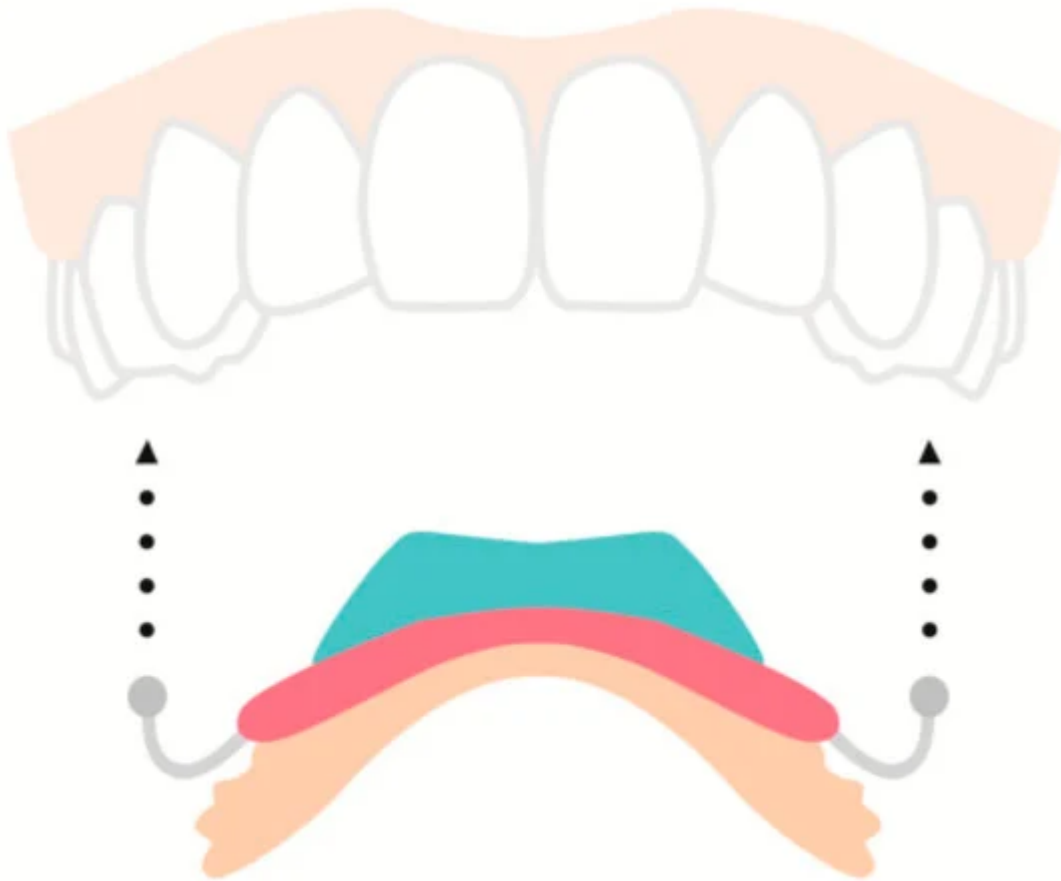


Figure 1. This oral device is placed in the upper palatal space and is secured by metal clasps right before initiation of eating. A microchip (shown in blue) records the device's temperature in order to monitor the user's compliance. It is designed to decelerate eating rate by decreasing oral volume and the size of each bite ^[1].

Intraoral splints for both the upper and lower jaw, extending about 3 mm over the premolars and molars, reduce oral capacity by 25% and alter eating behavior without preventing users from eating ^[2]. At a 12-month follow-up in a study where the device was used for a total of 4 to 8 weeks, all participants exhibited weight loss of up to 5% and an impressive 67% experienced 10% weight loss ^[2].

Furthermore, objects of everyday use, like cutlery, could be potentially modified in order to decrease eating rate, i.e., smaller spoons resulted in a decrease in ad libitum food intake by 8%, decreasing both mean bite size and eating rate ^[3]. A smart fork has been designed in order to assist the user to maintain a slow eating rate by determining meal duration and calculating total number of bites (Figure 2) ^[4]. The device vibrates and a red-light indication appears every time eating rate is accelerated (more than one bite per 10 sec) ^[4]. A three-armed parallel randomized controlled trial consisting of a group using the fork with vibrating feedback, a second group using the fork with access to online data (for eating rate and success ratio feedback), and a third group using the fork with no feedback resulted in weight loss in the intervention groups ^[5]. At a follow-up, participants maintained a decreased eating rate by longer spacing between bites and a lower bite rate ^[5].

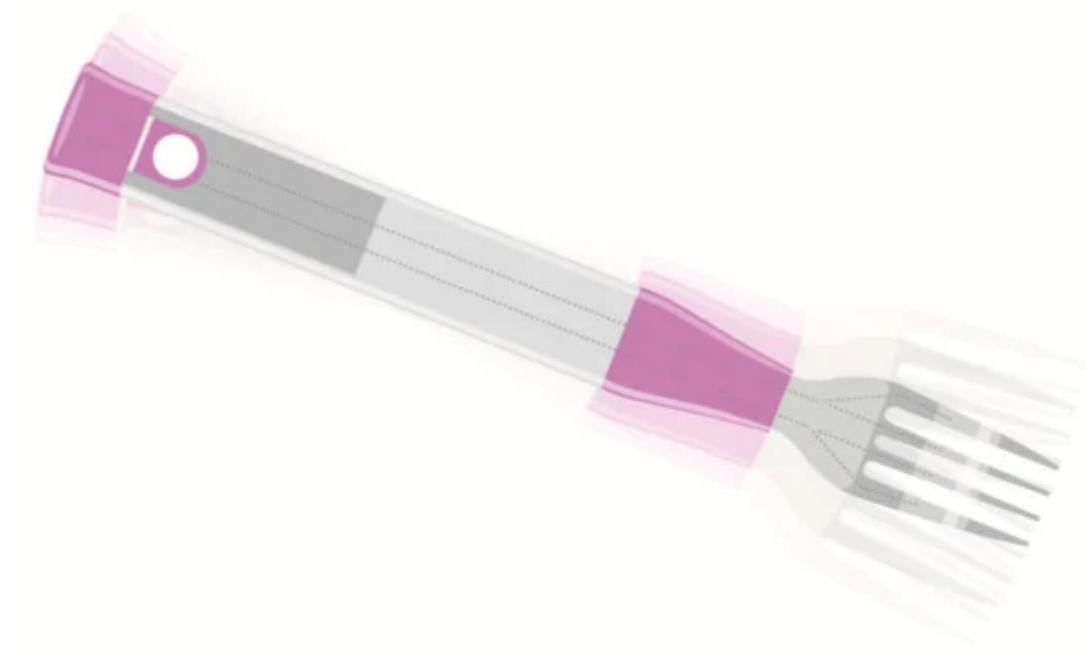


Figure 2. A smart fork that helps the user to decrease eating rate by calculating eating speed and meal duration. A red-light indication and a vibration appear when eating rate is accelerated [4].

A pneumatic fork that changes its body shape by inflating and deflating through a small pump and valve has also been used for the detection of accelerated eating rate (Figure 3) [6]. It bends when deflated, making it unable to eat with [6].

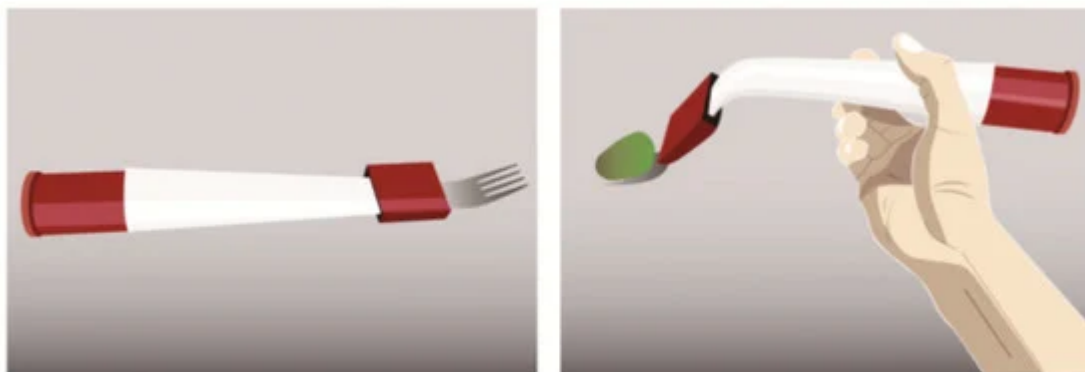


Figure 3. A pneumatic fork that changes its body shape by inflating and deflating through a small pump and valve depending on the detected eating rate [6].

2. Wearable Devices

The detection and monitoring of eating habits can also be conducted using smart eyeglasses with integrated electromyography electrodes on each side that provide skin contact with the ears [7]. Via high detection of chewing and eating events (ca 80%), the device could possibly contribute to dietary monitoring [7]. A device providing visual feedback via an application on a smartphone attempts to manage body weight by manipulation of eating rate [8]. An

electronic scale is connected via Bluetooth with the smartphone and measures the gradual reduction in food on the plate. Self-recording of hunger and fullness is also available on the screen (Figure 4) [8].



Figure 4. A custom-made electronic scale that is connected via bluetooth with a smartphone application measuring the reduction of the food placed on the scale along with self-recording of hunger and fullness [8].

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