

## Sleep Disorders. Part 1. Are We Ignoring Snoring?

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In the summer of 1942, I worked as a laborer in a Colorado construction camp. This was my first experience with barracks life. The government had contracted to build a training camp for mountain troops, later to be called Camp Hale. The work schedule was brutal—from 7:00 a.m. to 6:00 p.m. each day. Temperatures during the day exceeded 95 degrees. At night it would sometimes drop below freezing—the altitude was over 10,000 feet. After dinner each night the old-timers would play poker and drink whiskey until the early hours of the morning. I never understood how they could sleep for just three or four hours and then put in a full day's work digging ditches with picks and shovels. But when they did sleep, the sound of their snoring was deafening. When I first arrived, it was loud enough to keep me awake until dawn. But after putting in a day of digging trenches myself, neither snoring, lights, radios, nor conversations could keep me awake.

This was my own personal introduction to coping with snoring. Ironically, about two years later I returned to that same army camp after basic training. In the army I once again learned the power of fatigue in reducing the effects of snoring noise pollution. But, for many a weary spouse or roommate, the snoring problem is not so easily overcome. Snoring has caused countless marital disputes and even provoked divorce cases.<sup>1</sup> In his book, *Snoring*,<sup>2</sup> the late Marcus H. Boulware described instances in which snoring provoked assault, as well. In one

case, a woman charged by her husband with assault testified in court that after listening to his unbearable snoring and asking him three times to roll over, she "tapped him lightly with a billy club."<sup>2</sup> Spouses are not the only ones annoyed by snoring. John Wesley Hardin, the infamous gunfighter of the American frontier, is said to have been so upset about the snoring of a fellow guest in a hotel that he shot and killed the man.<sup>3</sup>

Hardin's solution to snoring was perhaps extreme. But if one has never listened to truly loud snoring, it may be difficult to imagine what some people must put up with. Some snorers really do shake the fixtures and wake up the neighbors.<sup>4</sup> In one study, snoring was measured at up to 69 decibels,<sup>5</sup> and in another, it was recorded at 80 decibels.<sup>6</sup> By contrast, a pneumatic drill breaking up concrete operates at a noise level between 70 and 90 decibels.<sup>4,5</sup> Imagine the noise level of a roomful of drunken soldiers!

This is the first part of a two-part essay on snoring. This part discusses snoring in general, its causes, and its numerous "cures." Part two will focus on a serious condition called sleep apnea, of which snoring is an important symptom. Sleep apnea has aroused growing interest within the scientific community in recent years, and has raised the possibility that snoring can be a medical, as well as a social, problem.

Snoring occurs when the upper respiratory tract becomes obstructed. This can happen during sleep because the

muscles in and around the throat relax. This may allow the tissue which lines the airway to sag a bit. If you are lying on your back the loss of muscle tone at the onset of sleep may permit the tongue and jaw to slide backward, resulting in a "bottleneck" in the rear portion of the throat, the oropharynx. As a consequence, you may begin to breathe harder, and to take in air through the mouth.<sup>1,6</sup>

A fast-moving column of air may meet resistance and induce vibrations at various points along the upper airway, but the most important resonating tissues are those which line the oropharynx, especially the soft palate and faucial pillars.<sup>5</sup> The locations of these and other structures in the upper airway are shown in Figure 1. The soft palate is the fleshy portion of the roof of the mouth which projects toward the back of the throat and terminates in a conical, dangling structure called the uvula. Heavy breathing, or mouth-breathing, may produce a "drag" on the edge of the soft palate and cause it to vibrate. A similar principle is at work when a saxophone reed vibrates, or a flag flutters in the breeze.<sup>5</sup> The faucial pillars are folds of mucous membrane which stand at either side of the oropharynx, connecting the pharynx walls to the outer edges of the tongue and soft palate. They, too, are prone to resonate. The loudness of a snore depends on how forcefully air is being drawn in and how much resistance it is meeting. The pitch and tone of the snoring are a function of the thickness and consistency of the tissues which are vibrating.<sup>5</sup>

Most snoring occurs when people are breathing through their mouths. Although it is possible to breathe noisily through the nose, the sounds emitted are more like humming or snorting than actual "guttural" snoring. Similarly, many people snore only while lying on their backs, the position most likely to cause obstruction in the throat, but some also

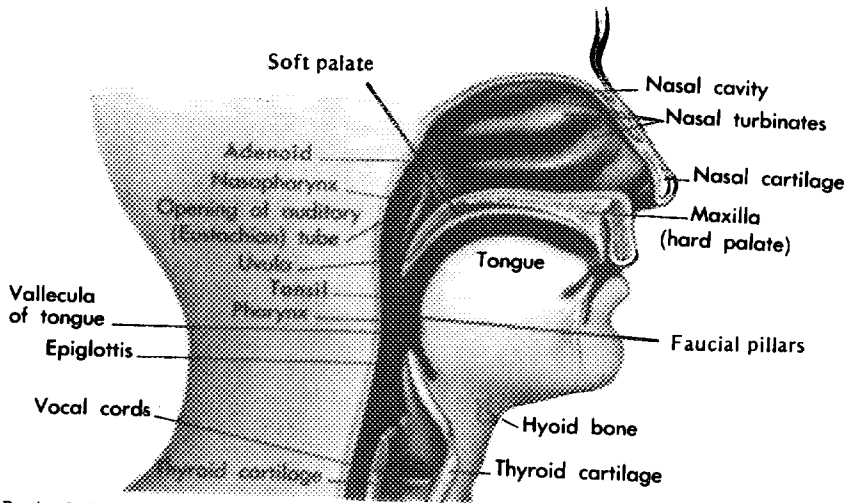
snore when on their stomachs or sides. A large survey conducted in Italy by the World Health Organization, for example, found that ten percent of adults snore loudly enough to be heard in the next room, regardless of what position they are in.<sup>7</sup> This type of snoring is often referred to as "heroic," "obnoxious," or "legendary" snoring.

Although we do not know exactly what percentage of the population snores, recent epidemiological studies suggest that roughly 31 percent of males and 19 percent of females are "habitual" snorers. Percentages of those who snore "occasionally" are higher: 53 percent for men and 38 percent for women.<sup>7</sup> Epidemiological studies have confirmed the popular idea that snoring increases with age. Elio Lugaresi and colleagues, University of Bologna, found that 60 percent of men and 40 percent of women between the ages of 60 and 65 snored regularly. In the 30 to 35 age group, the percentages were only 20 for men and five for women.<sup>8</sup>

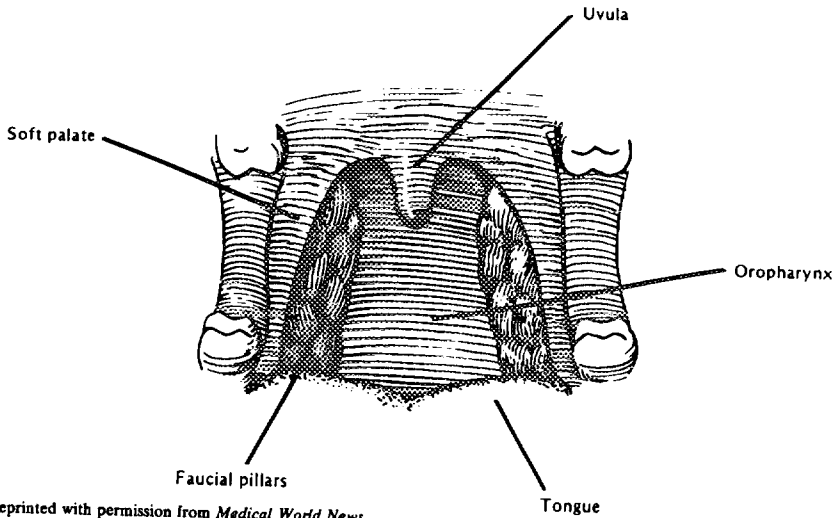
In most people, snoring varies, becoming loud and persistent during some stages of sleep, and growing lighter or even disappearing during others. Each night we go through several sleep cycles gradually alternating between light sleep, or rapid eye movement (REM) sleep, and deep sleep. Snoring is often heaviest during deep sleep. During REM sleep, the stage when dreaming occurs, snoring may vanish or grow irregular.<sup>8</sup>

Some people never snore at all. The reasons for this are not fully understood. One theory proposed by H. Tsukamoto and colleagues, Dairen Hospital, Dairen, Manchuria, in 1938<sup>9</sup> and still widely accepted<sup>10</sup> suggests that in non-snorers muscular relaxation during sleep is accompanied by a reduction in the volume of the nasal mucous membranes. This is presumably due to a decline in the amount of blood flowing to these areas. This widens the upper airway and obviates the need for mouth-breathing,

Figure 1: Side and front views of the anatomy of the upper respiratory tract.



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which, in turn, reduces the likelihood of snoring.<sup>10</sup>

E.L.C. Broomes, Lakeside Medical Clinic, East Chicago, Indiana, has suggested that non-snorers may have a different type of reflex, one which simply causes them to change their sleeping position rather than snore.<sup>11</sup> Another

important factor may be muscle tone. Some muscle tone is automatically lost during sleep so the tongue, soft palate, and throat lining become softer and more pliable. But according to David N. F. Fairbanks, George Washington University Hospital, Washington, DC, non-snorers, particularly younger ones, may

maintain enough muscle tone during sleep to prevent their tissues from vibrating.<sup>12</sup>

Heavy or continuous snorers may not have any habits or apparent physical traits which differentiate them from non-snorers.<sup>6</sup> But some habits and anatomical characteristics do tend to promote snoring either by causing obstruction of the upper airway or reducing muscle tone in the throat. For example, according to Boulware, gluttonous eating at bedtime can cause nasal discharge, irritation, and swelling or "edema" in the mucous membranes, which can constrict the upper airway and lead to snoring.<sup>2</sup> Likewise, eating heavily salted foods causes edema, with the same result. Alcohol, tranquilizers, antihistamines, or sleeping pills before bed can relax the throat muscles excessively and bring on snoring. Obesity has also been implicated in snoring. Excess weight leads to the accumulation of fatty tissue in the throat, and promotes back-sleeping and mouth-breathing. Many people have cured their snoring merely by losing weight or exercising regularly.<sup>13,14</sup>

Snoring can be a symptom of a medical problem. Colds, allergies, or clogged sinuses can interfere with normal breathing. Nasal deformities such as a deviated septum, or polyps (benign growths) in the nasal cavity, may cause snoring.<sup>2,15</sup> Loud or irregular snoring, particularly in children, may be the result of enlarged tonsils or adenoids. Tonsils and adenoids consist of lymphoid tissue which can become inflamed or overgrown, and thus obstruct breathing. Though tonsillectomies and adenoidectomies are no longer performed as routinely as they once were, some researchers such as Kenneth M. Grundfast, Children's Hospital, Washington, DC, believe that the operations are warranted in cases where they alleviate breathing difficulties.<sup>16</sup>

Occasionally, snoring can result from the shape or position of the structures in

the mouth. Many snorers have an unusually long uvula or soft palate, making it likely that these structures will fall back during sleep, partially blocking the airway. The combination of a large tongue and small jaws can cramp the tongue, which then bulges into the airway. A severe overbite can keep the lips from closing and the tongue from resting against the palate during sleep, all of which make mouth-breathing more likely. Loose or ill-fitting dentures can cause an unnatural relaxation of the muscles in the face and throat. Removing dentures, as most people do before retiring, may have the same effect. Some have found that wearing their dentures to bed cuts down on snoring.<sup>2,4</sup>

According to Fairbanks, in cases where snoring results neither from a medical problem nor from a physical deformity, there has traditionally been little medicine could do to alleviate it.<sup>12</sup> Instead, people have usually dealt with this "simple" or "garden-variety" snoring by sleeping in separate bedrooms or by admonishing the snorer to roll over.<sup>17,18</sup> When this fails, the next resort is sometimes an anti-snoring device. It is estimated that over 300 anti-snoring devices have received patents in the US during this century.<sup>17,18</sup> These include commercial versions of old folk remedies, newfangled electronic gadgetry, prosthetic devices which immobilize the tongue or jaw, and large apparatuses which lock the whole body into a "non-snoring" position.

One old and fairly common remedy for snoring is the "snore ball." Snore balls are small and usually made out of something hard. They are stitched to the back of the pajamas, often between the shoulder blades, to discourage back-sleeping. Colonial soldiers are reported to have used this technique during the American Revolution.<sup>2,13</sup> Other types of body restrainers which have been patented include wrist straps, designed to be fastened to bedposts, and body harnesses, which attach to immovable ob-

jects to keep you from rolling over onto your back.<sup>2</sup>

Many patented devices are designed to prevent snoring by curtailing mouth-breathing. These include gags, mouthpieces, and splints, which block the flow of air into the mouth. There is also a variety of muzzles, collars, head bandages, and chin straps, which keep the lower jaw firmly clamped against the upper one.<sup>2</sup> Although physicians are among the inventors of these contraptions, it is advisable to exercise caution with them. Some people rely on mouth-breathing because of blocked nasal passages or other problems. In a *New York Times* health column, Kenneth Hinderer, University of Pittsburgh, Pennsylvania, noted that, for this reason, cutting off the air supply from the mouth may actually be unhealthy.<sup>14</sup>

Some anti-snoring appliances are intended to prevent the upper airway from sagging, bulging, or fluttering during sleep. Nasal tubes, such as the "Better Breathing" plastic nasal tubes patented by H. Marlow, Brooklyn, New York, can be inserted into the nostrils to keep them open.<sup>2</sup> A neck collar, not unlike the type worn for a sprained neck, has been invented by Broomes. Its purpose is to prevent the head from slumping, which Broomes argues can kink the pharynx, or windpipe, and promote snoring.<sup>11</sup> There are also appliances which can be inserted into the mouth to pull the tongue forward and clamp it into a nonfluttering position.<sup>13</sup>

A more recent concept in snoring prevention is behavior modification. Electronic devices are now on the market which will "listen" for the onset of snoring. Ideally, the "feedback" provided by these devices trains and conditions the mind to avoid snoring. One such appliance is the Crossley Collar, invented by Robert Crossley, Austin, Texas, and inspired by his sleepless wife, Ruth. The collar features a microphone and a pair of electrodes which deliver a mild shock

to the neck each time snoring is detected.<sup>19</sup> Other gadgets employ a variety of unpleasant sensory stimuli. One, for example, activates a sequence of five alarms, starting with a light, followed by a flashing light, a buzzer in the ear, a mechanical blow to the biceps, and finally, if snoring persists, an electric shock powerful enough to wake you up.<sup>17</sup> Another device triggers a tape-recorded message which says, "Sleep quietly, stop snoring."<sup>20</sup>

Some researchers find promise in behavior modification. David L. Butler, now with the Veterans Administration Medical Center, Topeka, Kansas, for example, found in a controlled study at Virginia Polytechnic Institute and State University, Blacksburg, Virginia, that mild electric shocks could prevent snoring for days, and even weeks, after the therapy was discontinued.<sup>10</sup> A similarly successful behavior modification experiment was reported by Stephen C. Josephson and Raymond C. Rosen, Rutgers Medical School, Piscataway, New Jersey.<sup>21</sup> Other researchers dispute the idea that behavior modification can cure snoring. Fairbanks is quoted in a *Washington Post* health column as saying that snoring is "an involuntary problem and [the snorer] cannot be psychologically trained to stop. He only can be trained to stay awake all night."<sup>17</sup>

In contrast to the behavior modification devices, most other anti-snoring devices have not been tested in controlled scientific studies, according to A. Jay Block, University of Florida, Gainesville.<sup>22</sup> Nor has much been written in the medical literature on the subject of snoring in general.<sup>2,5,14</sup> We asked Block why snoring has aroused so little interest in the medical community. He speculates that the problem may have its origins in sexism. Most of those disturbed by snoring are women, while most doctors have traditionally been men. Another reason why medical researchers have ignored snoring is that until recently, snoring was

not known to have physical complications. Thus it has been viewed, if anything, as a social ill and nothing more.

Within the past ten years, however, researchers have discovered a relationship between snoring and a breathing disorder called sleep apnea, the cessation of breathing during sleep. This disorder strikes primarily middle-aged, overweight men and may occasionally

become a severe health hazard.<sup>23</sup> Sleep apnea will be the subject of the second part of this essay.

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