Musculoskeletal Patterns in Patients With Voice Disorders

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Summary: This study correlated the ear, nose, and throat (ENT) and physiotherapy input on 26 patients who presented with voice problems and were found by the ENT surgeon to have a degree of musculoskeletal issues. It also looked for patterns of musculoskeletal findings. Although all patients referred were found by the physiotherapist to have musculoskeletal abnormalities, the correlation proved to be excellent among the subgroup of performers, but only fair-to-good among the other voice professionals. Certain patterns of musculoskeletal abnormalities were frequently encountered, including a high held larynx, a shortening or contraction of the stylohyoid and sternocleidomastoid muscles, and a weak deep flexor mechanism. In this small group, most patients seemed to improve, although it must be noted that management was not limited to physiotherapy. In summary, physiotherapy input proved helpful in the evaluation and management of this group of patients presenting with voice problems.

Key Words: Voice—Musculoskeletal—Physiotherapy—Larynx—Hoarseness—Cervical spine.

INTRODUCTION

Many patients present to voice clinics with voice problems and are found, during the examination, to have problems relating to the muscles or supporting structures of the larynx, as well as to the musculo-membranous true vocal fold. Consequently, it is not uncommon for speech-language pathologists, when called on to care for these persons, to investigate and suggest management protocols for postural issues in an attempt to correct these problems. Recently, some speech-language pathologists have begun working directly on tightly held perilaryngeal musculature, and they have identified rapid improvement in voicing parameters.1,2

The importance of posture to well-being is now well known and has become popularized through the works of authors such as Alexander, Pilates, Feldenkrais, and Rolf. Physiotherapy and osteopathy have become integral to the field of sports medicine, and to rehabilitation of musculoskeletal injuries.3–6

Only recently, however, have the fields of osteopathy and physiotherapy been applied to vocal problems.7,8 In this article, the authors present the findings and results of 26 voice patients examined
in the surgeon’s voice clinic, felt to have postural issues as a part of their vocal problem, and referred to a physiotherapist.

MATERIALS AND METHODS

Twenty-six patients are presented who sequentially presented to J.R. in 2002–2003 with voice problems that the surgeon believed had a postural correlation, and thus they were referred to E.B. for review and possible physiotherapy. Fifteen patients were performers, and 11 were nonperformers but professional voice users. Demographics are presented in Table 1, presenting complaints in Figure 1, and relevant medical history in Figure 2. Twenty-one patients never smoked, three smoked occasionally, and only two described themselves as heavy smokers.

At presentation to the surgeon (J.R.), 46% (12) had a normal appearing larynx. Among the others, 38% (10) presented with a prenodular/nodular pattern, 12% (3) had a red appearing larynx, and 4% (1) appeared to have a sulcus. Overall, 62% (16) were believed to have “tight” perilaryngeal muscles. Among the major diagnoses other than vocal fold mucosal pathology (often more than one) at initial presentation to the surgeon, the following were posited: reflux 65% (17), musculoskeletal issues 69% (18), voice overuse 13% (3), psychological issues (under the care of a psychologist or psychiatrist) 15% (4), and paresis or sulcus 8% (2).

This group of patients was also referred to, or actively under the care of, several other clinicians by the surgeon, which included speech-language pathologists 58% (15), gastroenterologists 31% (8), neurologists 12% (3), psychiatrists 12% (3), allergists 12% (3), and pulmonologists 8% (2).

Major findings by the physiotherapist are presented in Figures 3–5.

The neck findings by the surgeon correlated well with the physiotherapist in 73% (11/15) of the singers and in 27% of the nonsingers, for a total “good” correlation of 54% (14/26). The physiotherapist identified the abnormal findings described by the surgeon in 100% of patients.

The overall outcome, albeit subjective and from the perspective of the physiotherapist, for this group was favorable. It is shown in Figure 6. It must be recalled that most patients also underwent interventions by other specialties, and thus, outcome cannot necessarily be related directly to physiotherapy intervention.

DISCUSSION

Rolf has coined the phrase “equipoise” as an “ideal” state of posture in which the person stands upright. In this state, the head is held vertically over the perpendicularly oriented shoulder girdle, vertically over the hip joints and the pelvis, and vertically over the forward-facing feet. A plumb line through the coronal plane formed by the ears would

![FIGURE 1. Presenting complaints to the surgeon.](image1)

![FIGURE 2. Relevant medical history.](image2)
pass directly over the plane of the shoulders and hip joints. The eye plane is horizontal, and the rib cage is neutral. Rolf describes the spine as resting in the pelvis much as a person sits in a rocking chair.6

In Western society, however, this “ideal” state rarely occurs. Most people spend their time, both at work and at leisure, in a seated position in front of various consoles or screens. They tend to sit slouched, with legs crossed, pelvis tilted, and lower back stretched.

From a neck standpoint, the deep extensors, deep flexors, and binding muscles need consideration. The deep extensors of the back (Figure 7) encompass the erector spinae muscle group. These muscles support and span the spine and have as a major role maintenance of the upright position of the body. Their role in relation to the skull is extension, lateral flexion, and rotation of the head.9 The suboccipital muscle group (the muscles attached to the occiput) permit accurate positioning of the head. They extend and rotate the skull (Figure 8).

These muscles are, on the whole, countered by the deep muscles of the anterior neck. These muscles twist the head on the neck, and flex the neck (bend it forward). They include the scalenes and prevertebral muscles. These muscles attach from the cervical spine down to the upper two ribs (the scalenes), to the upper thoracic spines (longus colli), or up to the skull base (longus capitis).10–12 The longus colli is the primary anterior muscular stabilizer of the cervical spine.

In addition, four more superficial muscles, the sternocleidomastoid, levator scapulae, trapezius, and the splenius, “bind” the neck to the shoulder girdle. These muscles are the prime movers of the head, neck, and shoulder girdle. They can also provide stability in the event of reduced muscular support from the longus colli (Figure 9).

Unfortunately, because of the poor postural behaviors endemic in our society, the upper posterior deep neck extensors tend to become overly powerful and dominate the deep flexors, which in turn “pay out”, increasing in resting length. As a result, the longus colli is at a significant mechanical disadvantage.

With regard to the cervical spine, the reduced activity of the anterior cervical spine stabilizers leads
to inappropriate activity of the prime moving muscles in an attempt to stabilize the cervical spine, which initiates a cycle of further reduction in local anterior recruitment. This process will allow the cervical spine to adopt a position of extension unsupported. The anterior stabilizers, as a consequence of a crossbridge deficit and mechanical disadvantage, cannot produce sufficient force to maintain a “normal” cervical spine muscular balance. This cycle will realistically continue until musculoskeletal (and vocal) symptoms become present and treatment is pursued (E. Blake, personal communication, 2004).

In the opinion of E.B., under the conditions described, the global binding muscles (sternocleidomastoid, levator scapulæ, and upper trapezius) abandon their mobility role to adopt one of stability. This change is inappropriate from a spinal positional perspective.

Among these “binding” muscles, it is the sternocleidomastoid that is the most likely “culprit”. Its more mobile proximal attachments allow for greater positional change with increased muscular activity than its sternal or clavicular attachments. The positional change in this scenario will result in upper cervical extension and a consequential relative lowering of the stylohyoid muscle and, on the basis of contractile muscle lengthening principles, cause it to increase in activity, hence, raising the hyoid bone and vocal mechanism (E. Blake, personal communication, 2004).
This change is consistent with the clinical findings identified in this group of patients.

It is also likely that this same process described will lead to contractural shortening and strengthening of the posterior belly of the digastric because of its attachment on the mastoid process; also, the relative elevation of the hyoid will likely lead to further shortening of the other suprathyroid musculature (J. Rubin, personal communication, 2004). This process would, perhaps, help to explain some findings described by Roy and Leeper.1

Although this finding is somewhat simplistic, a forward position of the head results, especially if the muscular patterns become habitual (which they often do), resulting in increasing pressures on the joints between the vertebrae. It can also cause pressure (compression) on these (facet) joints. Several patients presented with such findings of the cervical spine.
Stiffness of the upper thoracic spine can also have an influence on cervical spine motion. If it is stiff going into extension, then this can require increased movement from the cervical spine to achieve a functional range of extension. Over time, this increased load has the potential to cause hypermobility of certain segments of the cervical spine versus their proximal and distal segments (E. Blake, personal communication, 2002).

From the standpoint of the larynx, the authors postulate that as the neck moves forward and there is the potential for shortening of some suprahyoid musculature, the resting position of the larynx elevates in the neck, thereby changing the shape of the vocal tract and potentially altering resonance and timbre. It may also resist forward movement of thyroid cartilage during singing, thereby potentially altering vocal fold tension. This point is anecdotal, and not yet proven, but of potential interest.

In voice users, musculoskeletal changes can, of course, occur from factors other than those directly related to the postural tug of war just described. For example, the conscious lowering of the fundamental frequency of the voice as described by Koufman and Blalock as the Bogart–Bacall syndrome is not infrequently associated with a low held larynx and tight lower sternocleidomastoid muscles. In the group of patients presented herein, this postural pattern did not occur with any degree of regularity.

It would similarly be easy to posit that “pushing” the upper register could be associated with increased perilymphal muscular effort, and the development of contracted suprahyoid musculature, particularly in persons who have not mastered the concept of “laryngeal tilt”.

Mathieson and Roy and Leeper, in extensive work combining speech therapy with laryngeal manipulation, have found vocal improvement to occur within a single session by working on the musculature and tendinous attachments to the hyoid bone. Lieberman et al. postulate that shortening (chronic contraction) of the cricothyroid muscle may occur in musculoskeletal related voice disorders. The etiology of chronic cricothyroid muscle contraction is currently unknown. What is apparent is that it is a common finding in the voice clinic population (although not specifically evaluated for in this group of patients). The cricothyroid muscle is important in that it is a key muscle in laryngeal tensioning. Techniques have been developed for working directly on the cricothyroid joint and muscle.

Many concepts put forward in this article are still in their early phases, and evidence is required to take into account the placebo effect. E.B. uses a biofeedback device for assessment of cervical spine position and muscle recruitment patterns. The authors are looking into the possibility of surface electromyographic recording of muscle work rate versus their antagonists. Patient satisfaction indices may prove another method for charting improvement.

SUMMARY

Twenty-six professional voice users are presented who were examined by J.R. with voice disorders, believed to have musculoskeletal issues in and about the head and neck, and were referred to E.B. (as well as other medical specialists). All patients were confirmed to have musculoskeletal abnormalities, and certain patterns of musculoskeletal abnormalities were identified and treated by E.B. Although the ENT surgeon (J.R.) correctly identified many aspects of the musculoskeletal abnormalities, more were identified by the physical therapist. There was amelioration of the presenting voice issues in most patients, although it cannot be definitively stated that this was directly due to the physical therapy.

REFERENCES


