FUNDAMENTALS OF OROFACIAL MYOLOGY

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Presenting a balance of theoretical and practical information on orofacial myology, this book covers tongue thrust and related disorders; offers guidelines for the dental specialist; explores considerations for the orofacial myologist; and discusses orthodontic concepts and procedures. Applied physiology, etiologies, diagnosis and prognosis, treatment approaches, sucking and other oral habits, and various professional matters are also detailed.

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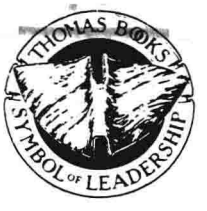

CHARLES C THOMAS • PUBLISHER
Springfield • Illinois • U.S.A.

Published and Distributed Throughout the World by

CHARLES C THOMAS • PUBLISHER
2600 South First Street
Springfield, Illinois 62794-9265

ISBN 0-398-05518-1 (cloth)
ISBN 0-398-06371-0 (paper)
Library of Congress Catalog Card Number: 88-20041

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Printed in the United States of America
SC-R-3

Library of Congress Cataloging-in-Publication Data
Hanson, Marvin L., 1932–
Fundamentals of orofacial myology / by Marvin L. Hanson and Richard H. Barrett.
p. cm.
Includes bibliographies and indexes.
ISBN 0-398-05518-1.— ISBN 0-398-06371-0 (pbk.)
1. Tongue thrust. 2. Oral habits. 3. Orthodontics. I. Barrett, Richard H. (Richard Howard), 1915– . II. Title.
[DNLM: 1. Fingersucking—therapy. 2. Mouth Rehabilitation. 3. Tongue Habits—therapy. WU 140 H251f]
RC429.H36 1988
617'.522—dc19
DNLM/DLC
for Library of Congress 88-20041
CIP

FUNDAMENTALS OF OROFACIAL MYOLOGY

PREFACE

We hate to say we told you so, but. . . .

Our faith in the basic validity of the profession of orofacial myology is of long standing. It was established before there even *was* such a profession, and certainly before it was called orofacial myology. Our faith held steadfast during the 1960s, when the field was largely either scorned or ignored. It did not falter during the 1970s, when it seemed that controversies would never be resolved.

It is therefore gratifying to note the increased recognition and acceptance of this province in the late 1980s, and to anticipate still broader growth in the 1990s. We do not expect the profession to fully mature until the next century; by then, we foresee the field being taught on the college level as a distinct discipline.

Our last volume devoted to this subject was published ten years ago. We had expected the arrival of other contributions during this interval, but no comparable work has appeared. This book, which modifies and modernizes our previous editions, fills the resultant void.

Although moving in that direction, orofacial myology still has not developed its own body of controlled research and derived therefrom a unique system of knowledge. To a large degree, it remains a melange, an admixture compounded of elements borrowed from the professions it serves. Readers already trained in one or another of those professions may therefore consider some portions of the chapters that follow to be superfluous. Even so, they may be interested in observing how those concepts are synthesized into the total fabric comprising orofacial myology.

This is the one area where dentistry and speech/language pathology overlap, bringing about shared goals and concerns. The dental hygienist also becomes involved and, to a lesser extent, one or two other professionals. Each has only partial knowledge of the total field of orofacial myology.

The purpose of this book is to provide a complete guide to the area. We have attempted to extract from each component realm the requisite teachings that it can supply. This book presents a balance of theoretical and practical information thus gleaned, designed to supplement the

training and knowledge of each basic field. It is therefore appropriate to serve as a textbook on the subject for advanced undergraduates and graduate students in dentistry, dental hygiene and speech/language pathology. All of this is in addition to the book's role as a text for direct training to becoming an orofacial myologist.

As we noted in the Preface to the first of our volumes, the learning of all the material included herein does not prepare the student to administer therapy. Book reading must be supplemented by extensive supervised work with patients of all ages, representing all of the disorders the field encompasses. We are now able to offer far more information than contained in our first edition, but there is still no substitute for guided experience.

M.L.H.
R.H.B.

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FUNDAMENTALS OF OROFACIAL MYOLOGY

CHAPTER ONE

TONGUE THRUST AND RELATED DISORDERS: AN OVERVIEW

Introduction

Orofacial myologists, speech-language pathologists, and orthodontists share a challenging problem: How to ensure permanence of results. Tongue thrusts, stuttering, and crooked teeth can all be modified, and the improvement substantiated with numbers. But what happens to the tongue thrust, the stuttering, and the malocclusion after treatment is terminated?

Few studies have been done in any of these areas. Three such studies are pertinent to our considerations as orofacial myologists. In chronological order:

1. In 1981, Uhde reported finding unacceptable occlusion in 49.2 percent of 72 orthodontically treated patients examined twelve years after the completion of treatment. Examination of these patients immediately following removal of retainers would probably have found acceptable occlusion in all of them.

2. Lopez-Gavito and associates (1985) found that more than 35 percent of a group of 41 subjects seen an average of nine years six months out of retention demonstrated a postretention open bite of 3 mm.

3. In 1987 Andrianopoulos and Hanson found significantly less orthodontic relapse in 17 patients seen an average of 7.4 years postretention who had received therapy for tongue thrust, than in 17 patients a like number of years following treatment who had not received therapy for tongue thrust. All patients had Class II, Division I malocclusions prior to orthodontic treatment. Those with therapy for tongue thrust had a mean relapse of 0.59 mm; those who had had no therapy for tongue thrust relapsed an average of 1.94 mm.

The editor of one reputable orthodontic journal rejected the Andrianopoulos-Hanson article, lauding the research it reported and the quality of the writing, but stating that its topic was not clinically relevant.

The reason therapy for tongue thrust came into existence was that orthodontists were concerned about the considerable relapse they were finding, weeks, months, and years posttreatment, in their patients who demonstrated tongue thrusting behaviors. People who provide therapy for tongue thrust see more patients who have overjets than those with other malocclusions. That is because orthodontists treat more patients with overjets than those with open bites, deep overbites, protruding mandibles, crossbites, and other types of malocclusions. Approximately 50 percent to 70 percent of patients with overjets have tongue thrusts. Ninety-eight percent of patients with open bites have tongue thrusts. The problem of relapse following orthodontic treatment *is* of grave clinical significance. This chapter will review relationships among tongue thrust, malocclusions, and treatment of tongue thrust. It will present strong evidence that treatment for tongue thrust is effective, not only in the short run, but for years following the completion of that therapy.

Semantics. The title of this volume uses the currently accepted name for the study of oral habits and their treatment.

Names are important. People who work with tongue thrust and related habit disorders now call themselves orofacial myologists or oral myofunctional therapists. The field they work in is orofacial myology. It used to be called tongue thrust therapy, but that name was too limited in scope. The therapist must not only eliminate the habit of pushing the tongue against the front and side teeth, but must also normalize functions of lip and facial muscles.

The area of cleft palate is now called "Craniofacial Anomalies." That is a good name, because it is precise and covers the scope of disorders related to cleft lip and palate. It is not so easy to say as "cleft palate," but it is better. A better name for "orofacial myology" might be "Oral Craniofacial Disorders." Professionals who treat these disorders are concerned with the inside of the mouth, with interrelationships between and within mandibular and maxillary structures, with function of the facial muscles, and with the appearance of the face.

"Tongue thrust" has been given many names in the past. Perverted swallow, deviate swallow, deviate deglutition, reverse swallow, infantile swallow, and visceral swallow are a few. The one that survived, tongue thrust, is too limited in scope, but it conjures up memorable visual images, and gets at the most harmful part of the disordered patterns. The others have been pretty much discarded, except by those who

initially coined them. We will take the liberty to use several terms in this volume, just to keep it interesting for you.

We are concerned with any habits, or behavioral patterns, that call attention to themselves because of their inappropriateness or that have an undesirable effect on teeth or on speech. These include thumb or finger sucking, tongue sucking, lip biting, object sucking or biting, or lip licking. The most harmful of all habits seems to be that of resting or pushing the tongue against the front teeth. Among speakers of English, the only time the tongue should have contact with the front teeth is while saying the "th" sound. It should rest against either the upper or lower gums, just behind the front teeth. It should squeeze up against the roof of the mouth during swallowing. When it pushes against the front or side teeth, or protrudes between the upper and lower teeth, a tongue thrust is occurring.

Tongue Thrust: Definition

That is a general definition of a tongue thrust. A more precise one is:

> Habitual resting or pushing of the tongue against at least ½ of the lingual surface area of the incisors or cuspids, or protrusion between the upper and lower anterior teeth.

The stipulation that the tongue contact at least ½ the surface area is arbitrary, but if only the portion of the teeth near the gingiva is contacted by the tongue, it is doubtful that the teeth will be moved by the resulting force.

Descriptions: Normal and Abnormal Behaviors

Normal Behaviors

In order to understand, identify, and treat abnormal eating and swallowing patterns, a knowledge of *normal* patterns is essential. A traditional description is offered: A person takes a moderate-sized bite of food and chews with the lips closed, allowing cheek and lip muscles to move the food toward the tongue as s/he chews. S/he chews just long enough to allow the saliva to mix with the food and form a cohesive bolus, right in the middle of the upper surface of the tongue. The tongue tip is positioned against the upper alveolar process, the sides of the tongue are positioned against the gums along the sides of the arch, and

no food is allowed to escape laterally or anteriorly during the swallow. The molars are occluded, the lip and cheek muscles are relaxed, and the food is moved posteriorly by a lifting or squeezing action of the tongue. First the blade lifts, and then the posterior portion lifts, while the tip and sides of the tongue retain their contact with the alveolar process. When the swallow is completed, the teeth and tongue are free of food particles. In 1813, Magendie described eating as consisting of three stages: oral, pharyngeal, and esophageal. Several sources have stated that the oral stage is both conscious and voluntary, the pharyngeal stage conscious but involuntary, and the esophageal stage both unconscious and involuntary. Having noted this tidy arrangement, some have then ignored its implications and proceeded as if the entire process were an unconscious, involuntary, global reflex.

Swallowing as a Reflex. Some examination of the description of swallowing as a "complex reflex" activity is thus necessary. Certainly it is a complex act, and there can be no dispute that portions of it are purely reflex. However, this description does not apply to all aspects of deglutition.

A reflex may be defined as the involuntary muscular contraction that results from the stimulation of a sense organ (Best and Taylor, 1961). With excitation of a receptor organ, a chain of events is set in motion that must be carried on to its irrevocable conclusion. It has been noted that swallowing is probably the most complex all-or-nothing reflex obtainable by peripheral nerve stimulation. But where does this reflex begin? Where are the end organs located that fire off the reflex? Most studies place them primarily in the tonsils and in the anterior and posterior pillars of the fauces, with other concentrations in the base of the tongue, the soft palate, and the posterior pharyngeal wall. A bolus reaches this region, and thus triggers the reflex, only at the conclusion of the oral stage of swallowing. To state that the second and third stages are reflex is quite correct, but if one wishes to initiate the reflex in the absence of food, it is first necessary to voluntarily collect saliva and voluntarily proceed through the oral stage of swallowing, after which the saliva may serve as a mechanical stimulus for the reflexive remainder. There is general agreement among authorities that the oral stage is not bound in the reflex; it is voluntary, and although it is usually unconscious, it may easily be called up to consciousness. It is doubtless performed in a habitual manner, but habit is quite different in terms of modification from reflex.

Even were the action a reflex, it could still be changed. It is only necessary to alter one element in the reflex arc to change the response. It

may be noted also that the pupillary reaction to light, Babinski's sign, and the contraction of blood vessels are highly inaccessible reflexes on the whole; yet, using modern biofeedback procedures, or under even a relatively moderate level of hypnosis, they become accessible to alteration.

Oral Stage. This is the *only* stage of eating with which the clinician need be directly concerned. Any abnormality that occurs is present only in this stage; once the bolus is delivered to the oropharynx, it may be consigned to its ultimate destination with a light heart.

Mastication. It is well to have some picture of the oral action immediately preceding swallowing. Mastication is a complex activity in itself: it is voluntary, although not always conscious. Placing food in the mouth does not trigger a reflex, although, once initiated, it may be continued on a subcortical level. It is centrally regulated by a relatively large area in the inferior medial portion of the motor cortex. Mastication may also be considered in three stages: incision, crushing, and grinding.

Incision. Incision begins with a lowering and protrusion of the mandible to bring the incisal edges of the upper and lower teeth into functional relationship. During incisal penetration of the food, the mandible is elevated continuously so that the incisal edges of the lower teeth contact the uppers and pass on over the lingual surfaces of the upper teeth.

Crushing. The food thus ingested is placed by the tongue and cheek muscles between the occlusal surfaces of one side or the other to be crushed by the molars and bicuspids. The lips are routinely closed and all the facial muscles are subjected to strenuous exercise during forceful mastication. Crushing is accomplished by a simple hingelike lifting and lowering of the mandible.

Grinding. The mandible moves in a somewhat rotary fashion, with the bolus being shifted occasionally from one side of the dental arch to the other. There is negligible tooth-to-tooth contact during mastication, the stroke being reversed immediately at the first proprioceptive signal of impending contact.

Bolus Formation. The spatulating action of the tongue maintains the food in a fairly cohesive bolus while mixing in the mucous and salivary secretions of the sublingual and submaxillary glands, thus serving to moisten and lubricate the reduced particles. Contractions of the buccinator muscle impregnate the bolus with ptyalin and serous fluid secreted by the parotid gland. The bolus is then centered on the dorsum of the tongue. The manner in which this is done is of vital importance to the clinician, for it is a pivotal concept in the retraining program presented

herein. The lips and cheeks suck against the outer surfaces of the teeth, pulling the bolus into a reasonably cohesive unit on the tongue (Strang and Thompson, 1958). This sucking action is a critical factor in initiating normal deglutition; it not only positions the bolus but to some degree continues through the entire oral stage. Facial muscles are active in the collection of dispersed food particles, or of saliva in the absence of food.

Bolus Movement. The first discrete movement preparatory to swallowing is a depression of the apex of the tongue as the bolus is moved forward in the mouth. A sucking action centers the bolus in a groove on the dorsum of the tongue; with a combined sucking and lifting action the tongue is then raised and a seal is established between the periphery of the tongue and the hard palate. The tip of the tongue at this point is most commonly on, or slightly anterior to, the incisal papilla, in which position it is able to achieve some stability; this is the free portion of the tongue (the muscles have no skeletal attachment) and to function efficiently they must therefore seek "anchorage" through sheer pressure against the alveolar ridge. The ingesta are completely circumscribed at this moment. The lateral margins of the tongue seal against the buccal teeth and adjacent palatal mucosa. Posteriorly, the pharyngeal portion of the tongue arches behind the bolus. The posterior pillars contract toward the midline, and the depressed soft palate moves inferiorly to seal against the tongue (Wildman et al., 1964).

Practically all the intrinsic and extrinsic muscles of the tongue, plus the suprahyoid muscles, are active as the bolus is positioned and propelled. In addition, the muscles of mastication routinely hold the teeth in firm occlusion, thereby supporting the act with increased mechanical stability, particularly with coarse food or a large bolus. However, molar occlusion is not essential to normal deglutition, for once the bolus is trapped between tongue and palate, there is less concern for what occurs in the oral cavity below the level of the seal.

Then begins the phase that has immortalized Ardran and Kemp (1955) for in almost every description of swallowing is an echo of their analogy of toothpaste being squeezed from a tube. The tongue presses forcefully upward in a wave of distal motion that has been characterized as a "stripping wave." The apex and lateral aspects of the tongue remain fixed, preventing escape of the bolus, while the pharyngeal segment of the tongue is depressed, releasing the bolus posteriorly.

The depression of the posterior tongue follows only an instant after elevation of the apex and is the first of two such movements that occur;

the entire oral stage is ordinarily completed in a fraction of a second. It is this initial lowering of the base of the tongue that allows access of the bolus to the receptor organs in the oropharynx, resulting in the firing of the reflexive pharyngeal stage.

Pharyngeal Stage. The tongue is sufficiently posterior to be in contact with the soft palate before the latter structure moves to close the nasopharyngeal port. As the velum touches the posterior pharyngeal wall, the pharynx, which has been elevated and expanded, is now squeezed from above downward. The base of the tongue, which dropped to allow passage of the bolus, rises, and the tongue next moves backward and downward. Concurrently, the larynx is brought upward and forward, which in turn carries the anterior wall of the esophagus upward and forward through attachment to laryngeal structures. The upper portion of the tube is suddenly pulled open, with a resulting drop in air pressure. Such negative pressure speeds the bolus still more, often projecting it deep into the esophagus.

Esophageal Stage. Once in the grasp of the esophagus, the bolus is propelled by peristaltic action. The primary peristaltic wave appears to be almost a continuation of the stripping wave of the constrictors, so that the entire swallowing act, through all its stages, from original bolus formation to arrival in the stomach and reinflation of the respiratory system, is usually one continuous, synergistic, wondrously coordinated process. The peristaltic wave is preceded down the esophagus by a wave of relaxation, which facilitates progress of the bolus. This wave of relaxation also serves to relax the cardia, the orifice into the stomach, allowing passage through the cardiac valve.

Abnormal Behaviors

Tongue thrust is not a simple act, for it involves intrinsic and extrinsic lingual muscles and muscles of expression and mastication. It may occur while the tongue is at rest, during speech, or during swallowing. Since food swallowing includes all the elements of saliva and liquid swallowing, we will focus on abnormal eating behavior. Borrowing from several early writers in the field, yet not restricting our description to any one of them, we give the following "classic" description of a tongue-thrust behavior during eating.

The child takes a rather large bite of food. He chews it without making full use of facial muscles to move the food onto the grinding surfaces of the molars and onto the tongue. Instead, the tongue moves the food, first

against the teeth, then later, away from the teeth. Chewing is inefficient, and no well-formed bolus results. Scattered portions of food are moved posteriorly by the creation of an anterior seal between the tongue tip and blade, anterior teeth, and one or both lips. The molars are not occluded, and the tongue remains wedged between the upper and lower teeth, all around the arch. The circumoral muscles contract, especially the mentalis; the muscles of mastication remain flaccid, and suction carries the food back to the pharynx. When the swallow is completed, the tongue has not been effectively cleared of food particles, nor have the teeth. The tongue then often carries out a cleaning procedure by pushing again against the anterior and side teeth. The basic characteristic of a tongue thrust is that the tongue contacts with some degree of force the anterior teeth when it would not ordinarily do so. Any of the other elements of the eating, drinking, or saliva handling processes may or may not be abnormal. We will describe, in greater detail, manners in which they may vary from the normal in an individual patient.

The Approach. If the tongue is low and forward at rest, as is often the case, the tongue may remain forward or even protrude to greet the approaching food. If so, it probably will return there frequently during chewing.

The Oral Stage

*1. **Mastication.*** The mores of society and the unrelenting efforts of parents have usually prevailed in achieving lip closure during mastication; however, the impulse of the deviant swallower is often otherwise. The tendency toward open lips disrupts the fine coordination required to pass the bolus back and forth over the occlusal surfaces of the teeth. The tongue tends to maul the food rather than function with the exquisite precision required in normal grinding. Instead of forming a cohesive bolus, the tongue allows dispersal of particles throughout the anterior portions of the mouth.

*2. **Forming the Bolus.*** One of the most significant characteristics may be found in the process of bolus formation. With food or saliva tucked into every cranny of the vestibule and their lingual counterparts, it is no easy matter to prepare for deglutition. Several variations are seen. Some children (and adults) display an inept and exaggerated sucking process, dropping the mandible excessively to increase the volume of the mouth and thus reduce the pressure, tensing the mentalis to maintain an oral seal, or, in some cases, contracting the circumoral muscles while squeezing excessively with the cheek muscles. Others send the apex of the tongue