SCIENTIFIC ARCHIVES OF DENTAL SCIENCES (ISSN: 2642-1623)

Volume 6 Issue 3 March 2023

Mini Review

Ethology, Slant and Airway Focused Dentistry

Allen J Moses*

Retired, Sleep Disorders Research, Rush University Medical School, USA

***Corresponding Author:** Allen J Moses, allen@themoses.com

Received: March 07, 2023; **Published:** April 03, 2023

Abstract

Ethology involves investigation of certain behaviors under natural conditions to evaluate ways to improve function.

Intraoral sleep appliances that prevent obstructive sleep apnea align the maxilla and mandible in such a way as to dilate and stent the oropharyngeal opening. Interarch stabilization guides specifically position the mouth parts for laboratory fabrication of the oral appliance. Two types of interarch stabilization guides are compared in this paper.

Anterior stabilized interarch registration guides were considered the norm until recently. Based on ethological study, it was noted that anterior stabilization typically results in slant, or reduced posterior oropharyngeal opening. Based on the direction of functional contraction of the masticatory muscles, the anatomic phenomenon termed "elevator muscle crunch", in combination with anterior stabilization typically reduces the oropharyngeal opening.

Use of a posterior stabilization interarch registration guide, a recent innovation, that results in a parallel interarch arrangement, no slant and a larger, more patent oropharyngeal airway opening is discussed.

Applying ethological investigation and known anatomic principles to the practice of airway focused dentistry

Keywords: Slant; Airway Focused Dentistry; Anatomic Principles

Introduction

The 1973 the Nobel Prize in Medicine and Physiology was awarded to Tinbergen, von Frisch and Lorenz for pioneering work in the science of ethology [1]. Ethology involves investigation of certain behaviors under natural conditions using the scientific method to evaluate its application to improved functions. Lorenz defined the term fixed action patterns as instructive characteristic responses that would occur in the presence of identifiable stimuli reliably invariant within the species. In the ethological method a behavior measured response to a stimulus does not necessarily emphasize evolutionary adaptability, but the significance of the behavioral process. Ethologists not only query the "why" of functions but, "What are their consequences?"

Ethology is basically the science of watching, wondering and testing. It usually involves fieldwork or in this case clinical observation.

Human beings are unique among mammal species by having a combined airway and foodway. The pharynx, being unsupported by bone is flexible and collapsible. As a result, adult humans cannot breathe and swallow at the same time. The positive consequence is the development of speech. The negatives are the possibility of choking and obstructive sleep apnea (OSA), a disorder in which the tongue during sleep intermittently collapses on the pharynx to restrict breathing.

OSA is a relatively new disease [2]. Its pathophysiology was only recognized within the past 50 - 60 years. As its numerous morbid health consequences have been scientifically determined and technology developed to objectively measure its phenomenology, its diagnostic prevalence has multiplied in huge numbers. Continuous Positive Air Pressure (CPAP) has been shown to be a near universally effective treatment modality, but uncomfortable, bulky and having reduced patient adherence. Surgical procedures such

as uvulo-palato-pharyngoplasty, tracheotomy, tonsillectomy and adenoidectomy have had less than satisfactory results and low acceptance.

OSA has also been found amenable to treatment by dental protheses, many of which have high patient adherence but are currently not as robust a treatment modality as CPAP. Dentists in effect, align and stent mouth parts to maintain optimal airway patency in the pharynx, an anatomic structure contiguous to, but actually not in the mouth. It is known that the diameter and volume of the pharynx can be dilated and stented by appliances that reposition various parts of the oral apparatus. This nocturnal dilation and stenting is dependent on complex coordination of the interaction between the local bony architecture, neural, muscular, vascular, ligaments, cartilaginous disc and soft tissue.

Pharyngeal airway dilation and stenting is accomplished by the complex inter-reaction between at least seven neurological/anatomic factors:

1. Create optimal space for the tongue in the mouth
2. Advance the tongue anteriorly
3. Advance the mandible anteriorly
4. Stretch the mylohyoid muscle
5. Lower the mandibular position
6. Advance the hyoid bone anteriorly
7. Change the alignment of the masticatory muscles [3].

No one factor acting independently can accomplish unidirectional movement. All seven factors working in synchrony never cause unidirectional movement. Jaw movement resulting in pharyngeal airway dilation and stenting is always multidimensional [4].

The interarch relationship for an intraoral sleep appliance is not a normally sustained biofunctional position for the mouth. The ideal interarch jaw position for an oral sleep appliance is optimal airway dilation and stenting with the lips comfortably closed. Dilation refers to getting the airway enlarged, and stenting is keeping it open. An additional four dimensions need to be considered to determine interarch treatment position with an oral sleep appliance: protrusive, lateral, vertical and slant.

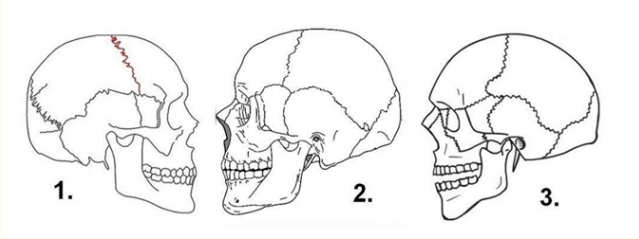

Figure 1: Sagittal sketches of three human skulls. #1. The arches are in centric occlusion. The upper arch is close to a flat plane to match the mandibular posterior teeth and create an occlusal plane for mastication. #2. The dental arches as they would be in rest position, essentially parallel to each other with no teeth touching. #3 shows a functional position such as shouting or screaming. The condyles advance out of the temporal fossae and the angle created between the maxillary and mandibular arches is defined as "slant".

Slant

In an anterior stabilized interarch jaw registration an acute angle seen between the plane of the mandibular teeth relative to the plane of the maxillary teeth and narrower at the posterior than anterior is referred to as slant.

The ethologist looks at slant and asks, "Is this a fixed action pattern that is invariant?" "What are its consequences?" "Is this a behavior that is modifiable?" "Can understanding slant affect the registration of the interarch jaw position for an intraoral sleep appliance?"

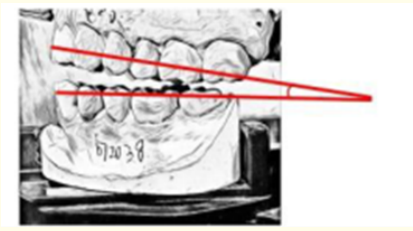

Figure 2: Red lines demonstrate slant on a set of mounted dental casts.

Slant appears to affect posterior airway size and patency. The ethologist asks, "Can slant can be changed or eliminated, depending on how the mandible is stabilized relative to the maxilla in registering the interarch jaw position for an intraoral sleep apnea appliance. Can stabilization in the anterior incisor area result in a different interarch jaw relationship, than from jaw stabilization in the molar area? Does slant in a sleep appliance not compromise posterior airway diameter and volume, while simultaneously increasing anterior opening, making lip closure difficult during sleep?"

Basis of study

Two specific techniques are possible for use in dental sleep practices to register the interarch jaw relationship: anterior incisal stabilization and posterior molar stabilization. In both techniques the vertical, lateral and protrusive dimensions are established using similar parameters and the same elastomorphic registration material is extruded to firmly establish the position. The significant difference in techniques appears to be where the stop is placed to stabilize the registration of the interarch jaw position.

A large majority of practicing sleep dentists currently use anterior or incisal stabilization devices to register the interarch jaw relationship, examples of which are the George Gauge™, Airway Metrics™, SomnoGauge™ and The Matrix™. This methodology initially seemed logical, but ethological study revealed previously unseen flaws. Incisor stabilization devices usually result in "slant", where the vertical dimension is greater at the anterior and reduced in the posterior at the location of the pharyngeal opening.

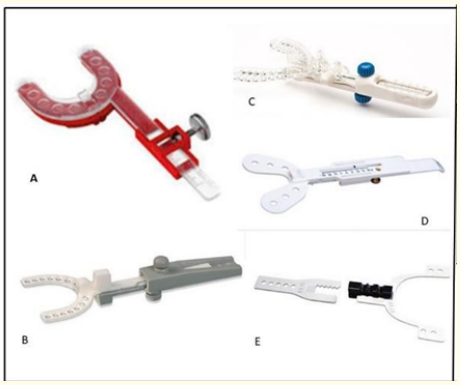

Figure 3: Left six different brands of anterior/incisal stabilization devices. The vertical dimension is determined by alignment of maxillary and mandibular teeth.

Figure 4: Left photos showing the interarch jaw relationships in four different cases being registered with anterior stabilization devices and all four demonstrating slant.

The test hypothesis

When the brain acts on the neural signal, "Close teeth on stabilizer", to establish the interarch jaw relationship using an anterior stabilizer, the focus of action is dictated by the elevator muscles in the molar area. With incisal stabilization there is a firm stop in the incisal area and no resistance in the molar area. The result is "Elevator Muscle Crunch", and its effect on interarch jaw registration is slant, characterized by reduced vertical dimension at the oropharyngeal opening.

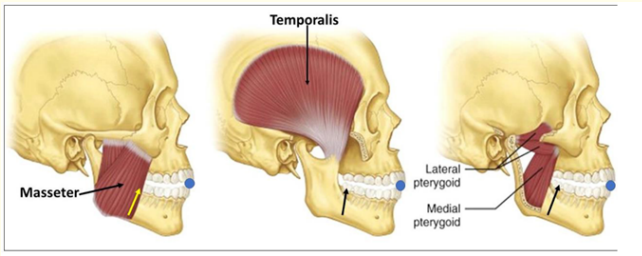

Figure 5: Above medical illustration of three skulls, identifying the elevator muscles, showing their direction of closure with arrows. The blue balls represent anterior/incisal stabilizers. With no posterior resistance to the overpowering force of the elevators, the result is development of slant, or "Elevator Muscle Crunch".

Discussion

Previously, it was not obvious that anterior incisal stabilization devices enable the elevator muscles to overpower the stopping force of the anterior area stabilizers in the molar areas, changing mandibular alignment and in effect detrimentally reducing oral space at the pharyngeal opening. The validating methodology is ethology, but objective studies are still warranted.

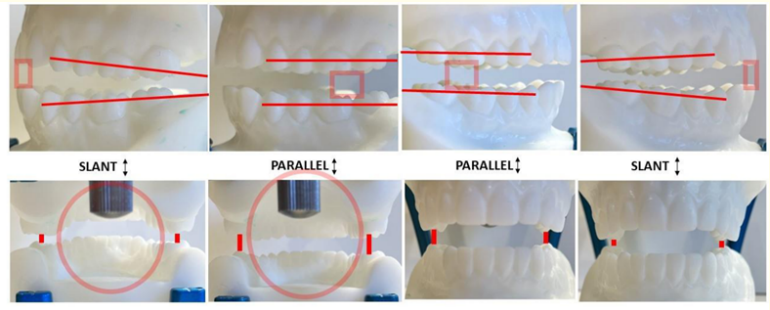

Figure 6: Dental models articulated to illustrate the differences in interarch relationship between slant and parallel relative to distal opening.

Posterior registration of interarch relationship

A posterior stabilization device [5] (X-Slant™ being the first to market) focuses the resistance bilaterally at the molar areas. With no appreciable contractile force in the anterior, parallel interarch planes and no posterior slant is the result. The science that validates posterior stabilization is basic applied anatomy with the focus of activity on the elevator muscles. Also, not obvious is the simple design factor of using a wire interarch coupler to achieve posterior bilateral stabilization for interarch jaw registration and the complimentary effect of parallel arches to maintain maximal airway patency.

X-Slant™, a new disposable posterior/molar stabilization system, makes it possible for a dental sleep clinician to factor the parameters of vertical, lateral, protrusive and slant into the design process for effective oral sleep appliances. Posterior/molar stabilization makes possible the capture of multidimensional movement, eliminates slant by aligning the dental arches parallel to each other (a normal biofunctional position) and enables normal lateral and protrusive shift to be registered.

X-Slant™ is comprised of the following parts: stackable shims and a shim coupler. The shims, are essentially square-shaped discs about 15 mm per side, having curved corners for patient comfort. The molar shim system is comprised of square-shaped, rigid plastic stackable shims of either 1.5 mm or 2.0 mm thickness and having two alignment pegs on one side and two matching apertures on the other side. Said pegs and apertures allow the shims to be stacked in a stable, accurate, vertical, friction-fit manner. The essentially smooth underside of the shims also has a slot to receive a rectangular arch-wire that connects two sets of stacked shims for bilateral positioning inside the mouth.

The patient closes on shim sets of varying heights placed bilaterally in the molar area until the clinician feels the proper vertical dimension is established. Bite registration putty is placed on the peg upside of both shim stacks, which is then placed in the mouth. Patient is instructed to close in a comfortable bite until the registration material is set. The patient is then instructed to slide along lower shim surfaces to where clinician determines is the best protrusive and comfortable lateral position and then instructed to hold that position. Bite registration putty is then extruded bilaterally in the interproximate areas between the lower molars, between the arches and over the lateral of the upper putty segment to fix that position.

Conclusion

While common sense might indicate that anterior stabilization in determining the optimal interarch relationship for an oral sleep apnea appliance is a sensible method, simple ethological study re-

Figure 7: A kit of posterior/molar stackable shims in two sizes and the interarch coupling wire that holds the shim sets in place.

Figure 8: Set of mounted patient models demonstrate use of posterior shims to establish parallel dental arches.

veals it to be inappropriate. The flaw of "slant" as a negative factor in registering the interarch jaw relationship has always been present. The concept of the elevator muscles causing slant by overpowering anterior stabilization devices was not obvious, but also, always there.

The advantage of a "parallel" interarch jaw relationship by utilizing posterior stabilization has always been present. There was just no commercially available posterior stabilization system. X-Slant™, is the newly available innovation for fixing an old, unrecognized problem. Once slant is recognized it is easily eliminated. A parallel interarch relationship for an oral sleep apnea appliance based on valid scientific methodology is the most anatomically correct position.

Seven neurologic/anatomic factors have been described earlier as being involved in the complex inter-reaction to establish oropharyngeal dilation and stenting in dental prostheses designed to treat OSA. Ethological study, applying known oral anatomic principles to current clinical protocols presents an eighth factor. The eighth anatomic factor essential in oral sleep appliance design is: "Eliminate maxillo-mandibular slant".

Bibliography

1. Dewsberry DA. The 1973 Nobel Prize for Physiology or Medicine: Recognition for behavioral science. Am Psychol. 2003;58(9):747-752.

2. Dement WC. The study of human sleep: a historical perspective. Thorax. 1998;53(3): 52-57.

3. Schwab RJ, Kuna SJ, Remmers JE. Anatomy and Physiology of Upper Airway Obstruction; In Princ and Pract Sleep Med; 4th edition. Kryger, Roth, Dement, Elsevier Saunders, Philadelphia, 82, 2005:983-1000.

4. Sicher's Oral Anatomy by DuBrul. CV Mosby, Philadelphia 7th edition, 1980.

5. United States Utility Patent Pending, 17/687,092, 03/04/2022.