

# Combat and Warfare In the Early Paleolithic and Medically Unexplained Musculo-Facial Pain In 21st Century War Veterans and Active-Duty Military Personnel

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## Abstract

In a series of recent articles, we suggest that family dentists, military dentists and psychiatrists with expertise in posttraumatic stress disorder (especially in the Veterans Health Administration) are likely to see an increased number of patients with symptomatic jaw-clenching and early stages of tooth-grinding (Bracha et al., 2005). Returning warfighters and other returnees from military deployment may be especially at risk for high rates of clenching-induced masticatory muscle disorders at early stages of incisor grinding. The literature we have recently reviewed strongly supports the conclusion that

clenching and grinding may primarily be a manifestation of experiencing extreme fear or severe chronic distress (respectively). We have recently reviewed the clinical and paleoanthropological literature and have noted that ancestral warfare and ancestral combat, in the early Paleolithic Environment of Evolutionary Adaptedness (EEA) may be a neglected factor explaining the conservation of the archaic trait of bite-muscle strengthening. We have hypothesized that among ancestral warriors, jaw clenching may have rapidly strengthened the two primary muscles involved in biting, the masseter muscles and the much larger temporalis muscles. The strengthening of these muscles may have served the purpose of enabling a stronger, deeper, and therefore more lethal, defensive bite for early Paleolithic humans. The neuroevolutionary perspective presented here may be novel to many dentists. However, it may be useful in patient education and in preventing progression from jaw-clenching to chronic facial pain.

## Introduction

Recently there has been a rapidly increasing acceptance of evolutionary perspectives in medicine (12, 16-18, 20, 27). There is also a slowly increasing acceptance of neuroevolutionary perspectives in psychiatry (13-15, 21, 26, 29-34, 36-39). More specifically with regards to neuroevolutionary perspectives of stress-induced and fear-circuitry disorders (see several recent reviews by Bracha and colleagues (2, 3, 10; 5-7). Although psychological stress has long been acknowledged to be a key factor in the pathophysiology of jaw-clenching, almost nothing has been written about clenching behaviors from a neuroevolutionary perspective. In a recent comprehensive review, we have summarized the interdisciplinary research literature in this area and presented a brain evolution based hypothesis of the distal etiology of this very common presenting symptom which very often precedes medically unexplained chronic facial or jaw pain (7).

We have recently proposed (7) that the strengthening of the masticatory muscles was a useful human trait as recently as the Paleolithic, i.e. a behavioral trait that enhanced the survival

odds of early humans. Clenching-grinding behaviors may thus be viewed as a conserved archaic response to periods of extreme chronic or inescapable acute stress that no longer serves a survival purpose for modern humans.

## Evolutionary Roots of Jaw Clenching and Teeth Grinding

As we have noted elsewhere, only recently has the attention of researchers shifted away from purely dental factors and toward synergistic neurobiological factors in the etiology of clenching-grinding spectrum disorders and the subsequent masticatory muscle pain (7, 8, 25). Elsewhere we have discussed interfaces between psychiatric research and dental research in areas other than jaw clenching and teeth grinding (1, 4, 9, 40). More recently, we have hypothesized that the evolutionary purpose of jaw clenching may simply be the strengthening of the masticatory muscles, a useful trait during the early paleolithic that enhanced the survival odds of early humans (the current term is hominins) (7). This recently published hypothesis is briefly summarized below.

Strong masticatory muscles are widely understood to have facilitated mastication and thus food consumption and survival of pre-Paleolithic hominins which lacked control of fire. However, as we have argued in a series of recent articles, psychological stress, in the early paleolithic Environment of Evolutionary Adaptedness (EEA) (which began approximately two million years ago and ended 200,000 years ago), may be a neglected factor explaining the conservation of this archaic trait even after humans were able to soften their food by cooking. We have hypothesized that jaw clenching may have rapidly strengthened the two primary muscles involved in biting, the masseter muscles and the much larger temporalis muscles. The strengthening of these muscles may have served the purpose of enabling a stronger, deeper, and therefore more lethal, defensive bite for early Paleolithic humans (*Homo ergaster*, previously known as *African Homo erectus*). This behavioral trait of clenching may have been selected into some human genomes and may be the basis of clinical teeth grinding.

It has traditionally been assumed that the origins of human warfare are recent. However, newer research has documented extensive human warfare in the early paleolithic EEA. Long periods of human evolution were characterized by frequent lethal interpersonal violence, both within and between groups (11, 24). Throughout the EEA and as recently as the Middle Ages, the majority of combat deaths did not occur on the battlefield. Instead, research suggests that combat deaths resulted from infection of infected wounds and the lack of effective treatment (23, 35). It is well documented that human bites are highly lethal due to the particularly virulent nature of the oral flora.

Due to the aforementioned intergroup violence, humans in the early paleolithic EEA were frequently subject to situations involving extreme fear and inescapable stress. In our recent review, we hypothesize that clenching, by exercising the bite muscles, provided an improved defensive bite within days for the paleolithic combatant. This occurred faster than could be achieved by incisor enamel sharpening. Therefore, jaw clenching may have been a survival response that evolved during the EEA during times of exposure to extreme and inescapable stress.

While clenching in other species has been little studied, incisor grinding has been documented in baboons and in several other species. A hypothesis related to our clenching hypothesis has been proposed for incisor grinding by Every (19) and recently expanded upon by Kleinberg (22) and by Murray and Sanson (28). These research dentists have argued that constantly sharpened incisors may have been a useful survival trait for the paleolithic combatant (22).

### Clinical Implications

Academic tertiary care dental centers typically see the tooth flattening (shortening) associated with late-stage advanced bruxism. However, we have previously proposed that the sharpening function of grinding is much clearer at earlier stages prior to the enamel chipping and dentin loss that eventually shortens and flattens the incisors. We posit that general dentists, military dentists, and clinicians in PTSD clinics (especially in the Veterans Health Administration) are much more likely to see patients at the earlier "sharp incisors stage." We predicted that new returnees from current military deployment may demon-


strate a high rate of clenching induced masticatory muscle disorders at early stages of incisor grinding.

In summary, we suggest that the alleles which wire the fear circuits to the brainstem nuclei activating the clenching-grinding behaviors were highly conserved in the human clade (lineage), since they enhanced the survival of anatomically and mitochondrially modern humans throughout the early Paleolithic. Although such evolved behaviors were useful survival traits for early humans, strengthening of masseter and temporalis muscles and tooth-sharpening has outlived its usefulness. The neuroevolutionary perspective presented here may be new to most dentists (and to many psychiatrists). However, in the VA system, we often observe what we believe to be progression from stress-induced involuntary jaw-clenching to chronic musculo-facial pain. Although more research is needed, we believe that explaining to the patient the archaic origins of this behavior may be helpful in educating patients and hopefully prevent chronic musculo-facial pain among civilians, VA patients, recent returnees from Operation Iraqi Freedom and Operation Enduring Freedom, and other active-duty military personnel. ■

### Reference List

1. Bracha HS: Can premorbid episodes of diminished vagal tone be detected via histological markers in patients with PTSD? *Int.J.Psychophysiol.* 2004; 51:127-133.
2. Bracha HS: Freeze, flight, fight, fright, faint: adaptationist perspectives on the acute stress response spectrum. *CNS Spectrums: The International Journal of Neuropsychiatric Medicine* 2004; 9:679-685.
3. Bracha, HS (in press): Human brain evolution, and the "neuroevolutionary-time-depth principle:" implications for the re-classification of fear-circuitry-related traits in DSM-V, and for studying resilience to warzone-related posttraumatic stress disorder (WR-PTSD). *Progress in Neuro-Psychopharmacology & Biological Psychiatry.*
4. Bracha HS, Blanchard DC, Lloyd-Jones JL, Williams AE, Blanchard RJ: Experimental Combat-Stress Model in Rats: Histological Examination of Effects on Amelogenesis - A Possible Measure of Diminished Vagal Tone Episodes. *Dental Anthropology* 2004; 17:79-82.
5. Bracha HS, Bracha AS, Williams AE, Ralston TC, Matsukawa JM: The

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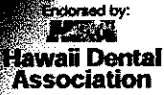
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- human fear-circuitry and fear-induced fainting in healthy individuals: the paleolithic-threat hypothesis. *Clin Auton Res* 2005; 15:238-241.
6. Bracha HS, Ralston TC, Matsukawa JM, Williams AE, Bracha AS: Does "fight or flight" need updating? *Psychosom.* 2004; 45:448-449.
7. Bracha HS, Ralston TC, Williams AE, Yamashita JM, Bracha AS: The clenching-grinding spectrum and fear circuitry disorders: clinical insights from the neuroscience/paleoanthropology interface. *CNS Spectrums: The International Journal of Neuropsychiatric Medicine* 2005; 10:311-318.
8. Bracha HS, Williams AE, Person DA, Ralston TC, Yamashita JM, Bracha AS: Reevaluating the management of chronic temporomandibular pain: are we treating PTSD with debridement and lavage? *Fed.Prac.* 2004; 21:50-52.
9. Bracha HS, Yamashita JM, Ralston TC, Lloyd-Jones J, Nelson G., Bernstein DM, Flaxman NA, Gusman F: Clinical research histomarkers for objectively estimating premorbid vagal tone chronology in Gulf War veterans' illnesses and in acute stress reaction in Formal descriptions of developing systems (NATO Science Series) Edited by Nation J, Trofimova I, Rand JD, Sulis W. Dordrecht, Kluwer Academic Publishers, 2003.
10. Bracha HS, Yoshioka, D, Masukawa, NK, and Stockman, DJ: Evolution of the Human Fear-Circuitry and Acute Sociogenic Pseudo-Neurological Symptoms: The Neolithic Balanced-Polymorphism Hypothesis. *Journal of Affective Disorders.* 2005; 120-129.
11. Buss DM: *Evolutionary psychology: the new science of the mind* Boston, Allyn and Bacon, 1999.
12. Cordain L, Gotshall RW, Eaton SB, Eaton SBI: Physical activity, energy expenditure and fitness: an evolutionary perspective. *International Journal of Sports Medicine* 1998; 19:328-335.
13. Cosmides L, Tooby J: From evolution to behavior: evolutionary psychology as the missing link in Latest on the best: essays on evolution and optimality Edited by Dupre J. Cambridge, The MIT Press, 1987.
14. Cosmides L, Tooby J: Toward an Evolutionary Taxonomy of Treatable Conditions. *J.Abnorm.Psychol.* 1999; 108:453-464.
15. Cosmides L, Tooby J: *The adapted mind: Evolutionary psychology and the generation of culture* New York, Oxford University Press, 1992.
16. Eaton SB, Cordain L, Lindeberg S: Evolutionary health promotion: a consideration of common counter-arguments. *Preventive Medicine* 2002; 34:119-123.
17. Eaton SB, Konner M, Shostak M: Stone agers in the fast lane: chronic degenerative diseases in evolutionary perspective. *Am.J.Med.* 1988; 84:739-749.
18. Eaton SB, Shostak M, Konner M: *The paleolithic prescription: a program of diet and exercise and a design for living* New York, Harpercollins, 1988.
19. Every RG: Significance of tooth sharpness for mammalian, especially primate, evolution. *Contrib Primatol* 1975; 5:293-325.
20. Ewald PW: *Symptomatic treatment (or How to bind The Origin of Species to The Physician's Desk Reference) in Evolution of infectious disease* Edited by Ewald PW. Oxford, New York, Oxford University Press, 1994.
21. Klein RG, Edgar B: *The dawn of human culture* New York, Nevaumont Publishing Company, 2002.
22. Kleinberg I: Bruxism: aetiology, clinical signs and symptoms. *Aust Prosthodont J* 1994; 8:9-17.
23. Lacey R, Danziger D: *The Year 1000: What Life Was Like at the Turn of the First Millennium* New York, Little, Brown and Company, 1999.
24. LeBlanc SA, Register KE: *Constant battles: the myth of the peaceful, noble savage* New York, St. Martin's Press, 2003.
25. Lobbezoo F, Naeije M: Bruxism is mainly regulated centrally, not peripherally. *J Oral Rehabil* 2001; 28:1085-1091.
26. Marcus G: *The birth of the mind: how a tiny number of genes creates the complexities of human thought* New York, Basic Books, 2004.
27. Morgan E: *The scars of evolution: what our bodies tell us about human origins* Oxford, Oxford University Press, 1990.
28. Murray CG, Sanson GD: Thegosis – a critical review. *Aust.Dent.J.* 1998; 43:192-198.
29. Nesse RM: Proximate and evolutionary studies of anxiety, stress and depression: synergy at the interface. *Neurosci.Biobehav.Rev.* 1999; 23:895-903.
30. Nesse RM: *Testing evolutionary hypotheses about mental disorders in Evolution in health and disease* Edited by Stearns SC. Oxford, Oxford University Press, 1999.
31. Nesse RM: On the difficulty of defining disease: A Darwinian perspective. *Medicine, Health Care and Philosophy* 2001; 4:37-46.
32. Nesse RM: The smoke detector principle. Natural selection and the regulation of defensive responses. *Ann N Y Acad Sci* 2001; 935:75-85.
33. Nesse RM: Natural selection and the regulation of defenses: A signal detection analysis of the smoke detector principle. *Evolution and Human Behavior* 2005; 26:88-105.
34. Nesse RM, Young EA: *Evolutionary Origins and Functions of the Stress Response in Encyclopedia of Stress, vol. 2.* Edited by Fink G. San Diego, Academic Press, 2000.
35. Salazar CF: *The Treatment of War Wounds in Graeco-Roman Antiquity (Studies in Ancient Medicine), vol. 21* Boston, Brill Academic Publishers, 2000.
36. Tattersall I: *Becoming human; evolution and human uniqueness* Orlando, Harcourt Brace & Company, 1998.
37. Tooby J, Cosmides L: The past explains the present: emotional adaptations and the structure of ancestral environments. *Ethology and Sociobiology* 1990; 11:375-424.
38. Tooby J, Cosmides L: Adaptations versus phylogeny: the role of animal psychology in the study of human behavior. *International Journal of Comparative Psychology* 2005; 2:175-188.
39. Tooby J, Cosmides L: The evolution of war and its cognitive foundations. *Institute for Evolutionary Studies Technical Report* 1988; #88-1:
40. Yui K, Bracha HS, Nishijima K, Kamata Y, Kato S: Pathological stress lines in human molars as a biological marker of early stress. *Brain Sciences and Mental Disorders* 2002; 13:443-450.

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