

# Dental Clenching: A Way to Improve Body Stability In Subjects Suffering From Whiplash Injury. Part 1: Patients With Physiological Occlusion

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## Abstract

**Aim:** Aim of this study is analyze the effects of dental occlusion on postural stability in patients with previous whiplash and normal occlusion..

**Materials and Methods:** 36 adult patients with previous whiplash and normal occlusion (good alignment, 1st class or mild 2<sup>nd</sup> class deep bite for mandibular retrusion) were selected. The patients were suffering from masticatory muscles pain caused by clenching during sleep.

**Exclusion criteria:** Use of Psych drugs: To simulate the conditions of sleep (with a reduction of proprio- and esteroceptive inputs for postural management performed by CNS), we used postural Romberg analysis (feet together, closed eyes) on stabilometric platform changing occlusal parameters only, under the following conditions: 1) in occlusal rest position, 2) in centric occlusion, 3) in clenching, 4) with occlusal disengage with cotton rolls and 5) in clenching on cotton rolls. Time of each test: 15 seconds. It was performed a statistical analysis with T-test comparing between them the mean of all tests.

**Results:** Stabilometry data (postural ball and ellipse) show better postural performances in centric occlusion and clenching in centric occlusion, and a worsening in all tests with occlusal disengage (with statistically significant difference -  $p < 0.05$ ).

**Conclusion:** Postural instability caused by whiplash increases muscles tone and dental clenching as compensatory effects, with onset of facial pain. An occlusal disengage (like an occlusal splint to reduce clenching) induces a postural worsening in patients with normal occlusion, while centric occlusion increases the stability. These results suggest that stomatognathic organ has a new physiological function: the posture stabilization.

**Keywords:** Posture; whiplash, dental occlusion, clenching, malocclusion, cranio-mandibular relationship, stabilometry, TMD, Temporomandibular disorders

## Introduction

Dental clenching is a condition that can induce dental abfraction, TMJ disorders, tension-type headache and facial pain caused by masticatory muscles hypertonus. This condition is usually considered an expression of psychological tensive status and therefore confused with psychogenic bruxism (teeth grinding) [1-6]. However, a meta-analysis of patients suffering from clenching and attending to Cranio-Facial Pain Center of Dental Clinic of Milan-Bicocca University shows that many patients have a story of a previous whiplash, a condition that induces postural alterations [7-10], as instability, dizziness, lumbar and cervical pain. These patients are also suffering from clenching, TMJ

pain and facial pain for muscle hyperactivity. We have therefore hypothesized that in particular proprio- and exteroceptive reducing (especially in case of the visual ones) and in the absence of podalic support, as in sleep, the postural system will search for better stability by teeth clenching. From the anatomical point of view the jaw actually represents the cranial insertion point of the anterior chain muscles, or rather some functional continuity circuit through which the various body's strengths spread (both dynamic and static) [11]. Hence the importance of this job is to technically evaluate the importance of the stomatognathic system in the postural stabilization, which had been previously disturbed by a traumatic event such as whiplash.

## Materials and Methods

66 patients with pre-existing whiplash have been selected (positive Romberg's test), all of them suffered from nocturnal teeth clenching which occurs in morning at waking up time with facial pain, masticatory muscles stiffness or pain spread throughout the dental arches. This testing job was composed in two parts since there were two groups of patients depending on their occlusal characteristics: group 1 was formed by patients with good dental occlusion, while group 2 was formed by patients with malocclusion. In this first part we have considered the results from the study conducted over patients with good dental occlusion, or rather with a good alignment of the dental arches, without dental formula reduction, cross bite, asymmetry in curves of Spee and Wilson, with a first class or mild second class deep bite due to a modest mandibular retrusion: generally speaking about patients with a good cranio mandibular relationship. 36 adult patients were selected with this criteria (18 males and 18 females, average age 33.19 aa, st.dev. St. 6.21 aa, range 25-45 aa) with pre-existing whiplash and physiological occlusion. Criteria for exclusion: malocclusion or use of prescription drugs or psychotropic substances. The postural evaluation done on stabilometric platform (Correkta platform – DL Medica, Milano, Italy) has analyzed the patients with the Romberg postural test (patients with feet together and closed eyes), it was run by a protocol created by Dr. Giacomello and therefore it carries his name (Giacomello's Protocol). It includes the implementation of five different tests during which it exclusively effects the dental arches relationships: 1) in rest position, 2) in centric occlusion (habitual or maximum intercuspitation), 3) in clenching with habitual occlusion, 4) in occlusal disengage with cotton rolls between the arches (e.g. two cotton rolls between the arches), 5) in clenching with cotton rolls between the arches. Each test lasted 15 seconds. Hence we proceeded to evaluate the stabilometric parameters obtained from the various tests (length of postural ball and ellipse area), by performing a statistical comparison via Student T-test of the paired facts for both postural variables in the tested conditions.

## Results

From the point of view stabilometric we considered what values to analyze the area of the ellipse and the length of the ball postural or work and then the effort made by the body to maintain upright posture and therefore a good balance. The ball posture is represented graphically by a broken line located within the polygon of support, and corresponds to changes made by the projection on the ground of the body center of gravity during the acquisition of the exam. It is an expression of the behavior of the body center of gravity itself.

The final values (average and standard deviation) obtained during the various tested conditions have been reported in Table 1 (postural ball length in mm) and in Table 2 (postural ellipse area

in mm<sup>2</sup>). The average values related to the postural ball length have been (in mm):

1. in rest position:	140.31	St. dev. 85.11;
2. in centric occlusion:	123.88	St. dev. 80.54;
3. clenching in centric occlusion:	118.69	St. dev. 83.99;
4. with occlusal disengage:	139.30	St. dev. 101.82;
5. Clenching on cotton rolls:	139.74	St. dev. 95.25.

The average values related to the postural ellipse have been (in mm<sup>2</sup>):

1. in rest position:	318.69	St. dev. 267.18;
2. in centric occlusion:	282.08	St. dev. 246.71;
3. clenching in centric occlusion:	242.08	St. dev. 220.62;
4. with occlusal disengage:	374.27	St. dev. 366.20;
5. Clenching on cotton rolls:	670.02	St. dev. 956.86.

We then proceeded to the statistical analysis for comparison of the averages obtained from the various conditions by Student's t test for paired data. However, to give significance to the comparison, were considered for postural ball length the averages achieved under the following conditions:

1. Rest Position - Centric:	0.026 (p <0.05);
2. Rest Position - Clenching:	0.015 (p <0.05);
3. Centric - Clenching:	0.448;
4. Centric - Cotton rolls:	0.017 (p <0.05);
5. Clenching - Cotton rolls:	0.043 (p <0.05);
6. Clenching - Clenching on cotton rolls:	0.021 (p <0.05);
7. Cotton rolls - Clenching on cotton rolls:	0.965.

The postural ball length, expressing the work performance from the postural system to maintain its physiological balance, it results statistically minor in the habitual centric conditions and in clenching in comparison to all other analysis condition. Therefore we gathered that the dental intercuspitation represents in these patients a postural stabilizing condition, while placing in between the arches two cotton rolls (occlusal disengage) the postural system seems more disturbed with worsening performances.

Performing a similar procedure for the ellipse postural we obtained:

1. Rest Position - Centric:	0.403;
2. Rest Position - Clenching:	0.084;
3. Centric - Clenching:	0.451;
4. Centric - Cotton rolls:	0.042 (p <0.05);
5. Clenching - Cotton rolls:	0.013 (p <0.05);
6. Clenching - Clenching on cotton rolls:	0.008 (p <0.01);
7. Cotton rolls - Clenching on cotton rolls:	0.013 (p <0.02).

**Table 1:** Results of the postural ball in different tested conditions for patients with normal occlusion or mild deep bite (in millimeters).

Post Ball	Rest	Centric	Clench	Rolls	Cl rolls
1	88,13	84,48	145,01	83,97	76,24
2	89,02	189,69	103,69	269,45	196,23
3	126,82	84,12	42,87	73,24	175,84
4	33,15	77,83	38,49	50,46	82,55
5	30,40	22,84	21,68	20,85	24,55
6	58,39	42,67	43,60	44,40	123,18
7	60,73	47,04	45,60	47,93	53,88
8	133,42	69,29	102,27	112,23	124,77
9	112,47	89,39	112,06	105,07	64,43
10	114,58	104,46	51,52	154,63	37,19
11	92,05	50,85	66,88	54,78	145,87
12	204,37	117,13	156,15	120,21	154,86
13	253,82	288,07	356,66	325,98	426,40
14	348,27	292,39	226,00	289,30	158,25
15	229,44	201,26	184,72	210,44	207,47
16	135,49	88,30	94,97	101,67	85,52
17	87,13	79,55	139,50	82,75	74,84
18	90,78	183,67	105,32	273,43	193,40
19	125,75	88,44	45,99	168,44	173,97
20	35,35	82,40	37,17	47,90	85,90
21	29,54	21,85	18,63	18,94	27,43
22	60,78	39,67	38,47	47,22	131,79
23	59,75	48,98	48,35	46,53	52,50
24	138,72	74,75	98,48	114,93	126,93
25	116,00	92,34	109,29	103,82	58,94
26	123,44	99,63	55,85	49,89	34,38
27	87,48	47,90	59,11	57,39	41,99
28	199,57	123,89	161,77	118,45	157,50
29	260,73	297,37	360,32	392,66	435,38
30	364,93	288,36	218,82	398,30	248,58
31	238,79	197,38	176,31	205,38	208,41
32	129,38	93,43	88,74	99,84	79,29
33	170,96	168,00	176,85	151,93	168,85
34	229,44	210,44	184,72	201,26	207,47
35	177,53	176,35	185,94	160,22	180,40
36	214,63	195,67	171,09	210,89	205,39
<b>Average</b>	<b>140,31</b>	<b>123,88</b>	<b>118,69</b>	<b>139,30</b>	<b>139,74</b>
<b>St Dev</b>	<b>85,11</b>	<b>80,54</b>	<b>83,99</b>	<b>101,82</b>	<b>95,25</b>

**Table 2:** Results of the extension of the postural ellipse in different tested conditions for patients with normal occlusion or mild deep bite (in square millimeters).

Ellipse	Rest	Centric	Clench	Rolls	CI rolls
1,00	115,13	189,58	372,12	224,22	261,54
2,00	261,68	997,88	607,54	1511,25	3553,52
3,00	495,42	209,95	108,26	1339,49	2456,82
4,00	19,35	257,73	53,56	193,59	112,74
5,00	8,45	2,23	2,36	1,97	3,10
6,00	139,51	96,45	119,35	458,79	1762,77
7,00	53,65	106,62	30,36	124,93	70,17
8,00	133,42	69,29	112,23	102,27	124,77
9,00	112,47	89,39	105,07	127,06	64,43
10,00	385,21	571,97	50,37	72,30	55,35
11,00	934,10	586,52	682,97	547,90	468,61
12,00	351,40	99,95	120,38	290,50	189,75
13,00	269,49	361,66	626,49	676,38	748,82
14,00	894,20	474,61	310,89	423,67	679,04
15,00	523,30	354,67	331,42	399,10	335,10
16,00	248,55	74,50	94,40	191,15	176,90
17,00	118,22	195,53	665,43	229,79	257,93
18,00	264,39	1005,34	598,35	1475,31	3278,89
19,00	502,74	209,95	102,23	351,82	2964,34
20,00	21,21	264,31	47,10	198,31	138,93
21,00	10,31	4,31	1,80	2,02	4,10
22,00	143,89	86,20	114,47	462,43	1689,32
23,00	49,20	102,59	27,76	78,35	99,44
24,00	128,36	60,64	108,43	109,93	145,89
25,00	117,05	92,23	99,05	108,35	64,29
26,00	401,19	564,83	47,76	180,10	149,56
27,00	921,39	563,39	658,98	534,95	489,04
28,00	364,90	94,03	109,81	228,89	201,18
29,00	273,29	347,90	589,58	485,72	975,36
30,00	903,91	489,02	298,85	411,04	703,99
31,00	535,20	342,97	320,86	407,40	329,47
32,00	255,20	68,03	84,86	184,50	142,26
33,00	242,16	213,33	232,83	175,58	325,61
34,00	523,30	354,67	331,42	399,10	435,10
35,00	252,72	221,93	239,72	381,12	339,97
36,00	499,02	330,74	307,93	384,37	322,76
<b>Average</b>	<b>318,69</b>	<b>282,08</b>	<b>242,08</b>	<b>374,27</b>	<b>670,02</b>
<b>ST Dev</b>	<b>267,18</b>	<b>246,71</b>	<b>220,62</b>	<b>366,20</b>	<b>956,86</b>

Even in this case we observed better conditions in the habitual centric and mostly in clenching in centric occlusion, while the analysis condition with occlusal disengage they result significantly worse, particularly if we consider the condition of clenching on cotton rolls which represents an average much higher than all other tested conditions.

### Discussion

The cervical whiplash traumatic pathology is the consequence of a subsequent trauma in which an abrupt acceleration and the following deceleration will cause the violent stretching and bending of the neck. The social incidence of the whiplash needs to be evaluated not only in diagnostic-therapeutically terms, but also epidemiological; such lesion in fact it represents one of the major subsequences of trauma from road accidents; additionally is one of the principle causes of postural disturbance of traumatic origin [12-15]. Moreover it needs to be remembered that posture is the ensemble of the relations among the various body parts and of the entire body in respect to the surroundings: is the behavior, the position that men acquire in the space [16]. Mechanically evaluated, posture is highly connected to the continuous effort made by the spine's muscles of extension which allows a bipodal behavior in orthostatism. Among the postural consequences of the whiplash there is a positive result to the Romberg test, it is caused by a displacement of the body barycenter due to a compensatory muscle adaptation with spasms that are finalized to maintain the balance. Many patients that have suffered from this trauma they will present in time gnathologic problems (coronal fissures and fractures, periodontal occlusal trauma, TMJ pain, or alterations of the articular morphology, muscle pains with possible arising of headaches) and tendency to dental arches clenching, phenomenon which usually happens during ones sleep. This disorder is especially registered as highly disturbing, because the subjects do not have a good rest while sleeping, and when the patients wake up they complain about facial pain or headaches due to the painful muscle masticatory and cervical stiffness.

It needs to be pointed out that patients recognize to have a tendency for clenching in a period of time subsequent to the trauma, and its appearance happens about 20-30 days after having suffered from whiplash. With the clenching it also worsens the algic symptomatology in charge of the cranio-cervical muscles, which was already suffering from the post-traumatic period; additionally clenching causes an excess of TMJ pressure which results with the manifestation of a algo-dysfunctional pathology (indirect lesive action). It needs to be mentioned that this articulation might be already suffering due to the trauma (direct lesive action) due to the typical abrupt whiplash cranio-cervical movement [17,18]. The purpose of this job consists in searching an etiopathogenic explanation of the indirect lesive action that stomatognathic system is subjected to in general, and particularly the TMJ effected from whiplash through a postural analysis approach: for this reason we created an experimental

protocol that would simulate the typical posture during sleep time. Therefore the Romberg test (feet together and closed eyes) highlights and simulates the postural strategies done by SNC in conditions of reduction of the proprio- and exteroceptive inputs (such as during sleep). In fact posture is a system that works following a cybernetic scheme made by incoming information (of polysensorial origin), a central processing from the central nervous system, and by outgoing information represented from the neuromotor output which operate the tonic activation of the muscles and it translates in a determined posture itself [19]. On a stomatognathic level, the proprioceptive inputs mostly come from the periodontal receptors activated in a condition of maximum intercuspitation (centric occlusion): therefore the shape and the placement of the teeth it conditions the jaw position which represents the insertion point of the frontal chain muscles of the body. It results in a malocclusion intended as an altered maxillo-mandibular relation in the three space levels causing body posture alterations. To confirm what has been observed from a functional anatomy point of view, many studies confirm the tight correlation between occlusion and posture, although this basic research has yet confirmed with certainty the relation [1,20-30]. Our study includes this debate by analyzing a sample of patients who have presented obviously postural trouble, since positive to the Romberg test due to whiplash injury: we have considered separately patients with and without malocclusion just to highlight the actual differences in the postural strategy used, and analyzing the stability values. In case of physiological occlusion the condition of maximum intercuspitation determines a higher postural stability in comparison to the test made in rest position, with a statistically significant difference ( $p < 0.05$ ); such effect was more evident in the test made with teeth clenching in maximum intercuspitation ( $p < 0,05$ ). It then results that bringing the teeth in occlusion this kind of patients present better postural performances, confirming the hypothesis of a postural stabilization effect from the stomatognathic system.

Moreover by placing a neutral occlusal disengage, as cotton rolls between the arches, the postural parameters analyzed show a worsening of the postural stability with a major energetic effort: in particular clenching over occlusal disengage represents the worse condition, with strongly significant differences in comparison to all other conditions tested ( $p < 0.05$ ) in regards to the postural ellipse area. As observed with many patients we can claim that maximum intercuspitation represents an important point of reference in neurological postural management, or else a fundamental fulcrum to guarantee body stability in subjects who suffered from whiplash. In addition the presence of a protective layer between dental arches (such as a splint, useful to protect the teeth from clenching), it induces a disturbance in a system that was already altered from a previous trauma, and it can be recognized as an ulterior bothering element. We can therefore deduce that the stomatognathic system becomes victim of a dysfunctional scheme that is recognized in the trauma itself (whiplash) the

casual element; it derives from it that all of its components (teeth, periodontium, TMJ and muscles) they could suffer from an excessive effort that in time it could induce them into permanent structural alterations. From a therapeutically point of view protecting the stomatognathic system with a splint it could result in a worsening of the postural stability just as it would happen when placing a thickness between the dental arches, inducing the subject to an increase of clenching for compensating a major postural instability. Nonetheless the presence of a bite disengage (splint) guarantees, at least momentarily, a protective effect over all the stomatognathic structures and particularly over the dental-periodontal system. Hence in addition to the gnathologic therapy it would be suggested to restore a correct postural behavior through physiotherapy or manipulative techniques: in these patients the splint will result as a protective tool with possible negative effects. Additionally this study allows to highlight the importance of this type of approach in medical-legal evaluations to determine the real entity of the damage from whiplash while extracting objective data in an evaluation that to this day still results being too symptoms-dependent. Still under this subject this study is to highlight the possible problems that, subsequent to whiplash, could arise over the stomatognathic system or TMJ in a medium to long term (6-12 months), with a protocol of instrumental objective analysis that highlights the importance of the stomatognathic system in the postural stability and its possible consequences that this structure could suffer in the time following a very common traumatic event: it needs to be noticed that the Giacomello's protocol is at the moment unique (and therefore it could be further perfected) in the medical analytical horizon. In fact in the event of indirect lesive action the insurgence of the problem results at a later stage and its detection during an acute phase while in Emergency Room it will result obviously impossible, contrary to those situations where the trauma determines a direct lesion to the TMJ or to the stomatognathic system.

### Conclusion

The present work represents the first part of a more complex project whose goal is to comprehend the importance of the dental occlusion in the postural system: for this reason we analyzed subjects that presented a postural instability with traumatic origin (due to a cervical whiplash injury) to evaluate the effects of the stomatognathic system over the postural performances. This first part has considered only patients with a good dental occlusion, analyzing their posture over the stabilometric platform with Giacomello's protocol, or else by doing 5 differentiated test of 15 seconds each during which only dental occlusion relation was modified: 1) in rest position, 2) in centric occlusion (habitual), 3) in clenching in habitual occlusion, 4) with occlusal disengage (e.g. two cotton rolls between the arches), 5) in clenching on cotton rolls between the arches. The results obtained in patients with physiological occlusion show a better postural stability statistically significant in conditions of habitual occlusion and in clenching in habitual occlusion, while the presence of an occlusal

disengage between the arches (which simulates in an artificial way a disengage splint) determines a noticeable worsening of the analyzed postural parameters, or else a worsening of the body stability over a postural base. Under this consideration dental clenching and muscular hypertonus must be considered an epiphenomenon consequent to the postural instability which is finalized to guarantee an improvement of the body stability. This is especially evident during sleep time since the subcortical management of the body posture is deprived from the proprioceptive information of podalic and vision origin (in this case of the exteroceptive ones too): in other terms the patient's CNS during sleep has to manage proprioceptive information of movement connected to the body unbalance state which determines at a subcortical level the sensation of instability which induces a neurophysiologic response to increase the muscle tone and to clench the teeth. By these results we can suppose that clenching is a way to increase the stability of the human body, above all in case of postural problems consequent to other causes as a whiplash injury. Clinically it attains a compensatory muscle stiffness, weariness and the need to clench in order to guarantee a referral point for the stabilization of the body posture. We can therefore suppose that to the four traditional functions recognized by the stomatognathic system (chewing, swallowing, phonation and breathing) it occurs to add a fifth function: the postural stabilization (in case of physiological occlusion). From a medical-legal point of view this job allows to analyze the gnathologic consequences of the traumas following a neurophysiologic vision and not strictly mechanical, recognizing both a direct and immediate lesive action (mechanical action), and an indirect lesive action (neurophysiologic). Moreover the chance to perform an instrumental evaluation on a stabilometric platform limits the importance of the subjective aspect to benefit an objective analytical approach, by following a precise protocol (Giacomello's protocol) which will require further developments and clarifications, but which represents the first model of evaluation of a phenomenon (the whiplash injury and its stomatognathic consequences) source of remarkable medical and legal controversies.

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