Relationship between occlusal factors and signs and symptoms of mandibular dysfunction

A clinical study of 48 dental students

Byron Droukas, Christer Lindée and Gunnar E. Carlsson
Department of Stomatognathic Physiology, Faculty of Odontology,
University of Gothenburg, Gothenburg, Sweden

Droukas B, Lindée C, Carlsson GE. Relationship between occlusal factors and signs and symptoms of mandibular dysfunction. A clinical study of 48 dental students. Acta Odontol Scand 1984;42;277–283. Oslo. ISSN 0001–6357.

Forty-eight young adults answered a questionnaire and were examined clinically for determination of symptoms and signs of mandibular dysfunction in accordance with the Helkimo indices. Occlusal conditions recorded included contacts in centric and excentric mandibular positions in accordance with specified criteria for registration of 'ideal occlusion', various occlusal patterns, occlusal interferences, and dental attrition. Relatively frequent but mainly mild signs and symptoms of mandibular dysfunction were found. The occlusal conditions were extremely varied and did not show any significant correlations with signs and symptoms of mandibular dysfunction. □ *Bruxism; dental wear; occlusal interferences; temporomandibular joint syndrome*

Gunnar E. Carlsson, Department of Stomatognathic Physiology, Faculty of Odontology, University of Gothenburg, Box 33070, S-400 33 Gothenburg, Sweden

The great importance previously attached to occlusal factors in the etiology of mandibular dysfunction has lately been seriously questioned on the basis of clinical, epidemiological, and neurophysiological studies (1–4). Still, however, the concept of an 'ideal' occlusion described in some 'classical textbooks' (5–7) has great impact on clinical procedures related to diagnosis and treatment of mandibular dysfunction and to occlusal rehabilitation (8, 9). Specific types of occlusal patterns are sometimes described as essential for a harmonious occlusal function (10), whereas scientific support for such concepts is scarce (11–13). It is the aim of this investigation to study the possible influence of some occlusal factors, especially various occlusal patterns, described as essential in analysis of occlusion in dental literature, on signs and symptoms of mandibular dysfunction in a non-patient group of young adults.

Materials and methods

Subjects

A class of dental students, 23 women and 25 men, participated in the study. The mean age was 25 years in both sex groups, the range being 20–38 years. The subjects had a full complement of natural teeth or lacked only single teeth. No one had a removable denture; a few had single artificial crowns. The subjects were in the 2nd year of their dental curriculum, participating in the first clinical course in stomatognathic physiology.

Subjective symptoms

A questionnaire modified from one previously presented (14) was used to collect data about symptoms of mandibular dysfunction, oral parafunctions, oral comfort, and chewing ability. The answers were used to record the anamnestic index of dysfunction, A_i (15). An index of present bruxism (0–2) was constructed by adding reports on awareness of present tooth clenching and grinding.

Clinical signs

The clinical examination was performed by two of the authors in accordance with routine procedures used in the Department

(16). When disagreement about findings occurred, a joint decision was taken. The observations were used to record the clinical dysfunction index, D_i, as described by Helkimo (15).

Occlusal variables

The recordings of occlusal factors were with small modifications those included in the occlusal index (15), with the following criteria. Occlusal contacts in intercuspal position (IP) were recorded by means of counting the number of teeth making perforations in a sheet of wax (Tenax wax, Ass. Dental Prod. Ltd, London) on which the subject bit hard. Contacts in the retruded contact position (RCP) were recorded as uni- or bilateral in accordance with the test person's tactile sensibility or, in case of uncertainty, with occlusal indicator wax (Kerr indicator wax, Sybron/Kerr Dental Prod. Division, Emeryville, USA). Contacts in laterotrusion to both sides and in protrusion were registered by direct visual inspection at a distance of 3 mm from IP. The RCP–IP distances were coded by the following scale: in the vertical and sagittal direction, 0 = 0–1 mm; 1 = ⩾ 1–2 mm; 2 = ⩾ 2 mm; and in the lateral direction, 0 = 0–½ mm; 1 = ⩾½–1 mm; 2 = ⩾1 mm.

Occlusal interferences

The following findings were recorded: unilateral contact in RCP; RCP–IP distance of 2 mm or more in the sagittal and vertical direction, ½ mm or more in the lateral direction; non-working side interference on right and left side preventing contact on the working side at 3 mm habitual laterotrusion from IP; unilateral contact in 3 mm habitual protrusion. An occlusal interference index was constructed by adding these recordings, which gave a theoretical value ranging from 0 to 7. An evaluation of the occlusion as 'ideal' was made if the following criteria were fulfilled: number of teeth ⩾28; number of occluding maxillary teeth ⩾12; no occlusal interferences; occlusal contacts in 3 mm laterotrusion on the working side on maxillary cuspids alone or on cuspids and neighboring teeth; and bilateral contacts in 3 mm protrusion. Otherwise the occlusion was registered as deviating from 'ideal'.

Attrition

Dental wear was registered in the incisor, cuspid, premolar, and molar regions separately in accordance with the following scale: 0 = no visible wear; 1 = wear of enamel only; 2 = wear into dentine on one or more teeth; and 3 = severe wear in the dentine. An attrition index was constructed by adding the figures for each dental region, giving a theoretical value ranging between 0 and 12.

Statistical methods

Standard computer methods for frequencies, medians, means, and standard deviations were used, in addition to non-parametric analytical methods such as the Spearman rank correlation (17) and Pitman's permutation test for correlations and significance of differences between groups (18).

Primary tabulation showed in general similar mean values for women and men (except for the greater maximal vertical mouth opening in the men). The results have therefore been presented for all subjects together.

Results

Reported symptoms

The frequency of subjective symptoms was in general low, clicking of the TMJ being the most common (19%), whereas crepitation was not observed. Headache more than once a week was reported by four subjects, and dysfunction symptoms such as locking of the TMJ and pain on movement of the mandible by three and two, respectively. None reported difficulty in opening the mouth wide, whereas two said they had noticed that previously. Otherwise there were only small differences between present and previous symptoms. Three students had been treated for such symptoms; six thought they needed

Table 1. Distribution of 48 dental students in accordance with the anamnestic (A_i) and clinical dysfunction index (D_i) of Helkimo

		No.	%
A_i	0	33	69
	I	8	17
	II	7	15
D_i	0	17	35
	I	25	52
	II	5	10
	III	1	2

treatment now. According to the anamnestic index, 2 out of 3 had no symptoms (A_i0), whereas 7 of the 48 students were classified as having severe symptoms (Table 1). Twenty-five per cent of the students were aware of bruxism (tooth grinding and/or clenching), a figure that increased to 44% when also earlier parafunction was included. The question of whether there was anything uncomfortable in the oral region was answered affirmatively by 14 (29%), whereas all considered their chewing ability to be good, and none had any phonetic problems.

Clinical findings

Nineteen students (40%) were recorded to have muscles tender to palpation and 17 (35%) impaired TMJ function (mainly clicking). The other signs included in the clinical dysfunction index were recorded only in a few individuals, giving a distribution of D_i shown in Table 1. One student only had an index value of III, and 6 (13%) had more than I.

Table 2. Mean ($\bar{x}$), median (M), and range of number of maxillary teeth with occlusal contacts in intercuspal position (IP)

Occlusal contacts	$\bar{x}$	M	Range
Right side	6.2	6	4–8
Left side	6.3	7	1–9
Total	12.5	13	8–16

Dental and occlusal observations

A wide variation of occlusal contacts in various mandibular positions was recorded (Tables 2 and 3). The type of occlusion according to laterotrusive contacts also varied substantially, contacts on the cuspids alone or in combination with one or more other pairs of teeth being commonest (Table 4). The same type of contact on both sides was seen in 42%. The distances between the retruded contact and intercuspal positions were generally small. Three subjects were recorded as having a sagittal and 12 a vertical distance of 2 mm or more, whereas 13 had a lateral deviation of 0.5 mm or more between RCP and IP. Seven individuals had no occlusal interferences, 18 had 1, 16 had 2, and 7 had 3 or more. Only three subjects were classified as having an occlusion close to 'ideal'; the great majority (94%) showed some sort of deviation from the criteria set up. Dental wear was on the average confined to the enamel for most of the teeth; 40% of the subjects, however, showed attrition into dentine on the cuspids, whereas this was recorded in about 15% for the other groups of teeth.

Table 3. Distribution of 48 dental students in accordance with occlusal contacts in retruded contact (RCP) and excursive contact positions 3 mm from IP. Figures denote number of individuals

	Occlusal contacts		
Occlusal position	Only right side	Only left side	Both sides
RCP	12	22	14
Laterotrusion to the right	34	2	12
Laterotrusion to the left	1	35	12
Protrusion	9	4	35

Table 4. Distribution of 48 dental students in accordance with type of occlusal contacts in laterotrusion 3 mm from IP

	Right side	Left side	Equal on both sides
Single tooth contact (one pair of occluding teeth)			
Cuspid ('cuspid protection')	19	12	9
Incisor	1	2	—
Posterior tooth	2	2	—
Group function (≥2 pairs of occluding teeth)			
Cuspid + other teeth	14	22	10
Incisors only	2	—	—
Posterior teeth only	5	3	1
Neither of the above patterns	5	7	28

Table 5. Significant Spearman rank correlation coefficients among A_i, D_i, and reported present bruxism and other variables

	A_i	D_i	Present bruxism
D_i	0.33*		
Present bruxism	0.35*	0.34*	
Present clicking (reported)	0.66***	0.34*	0.33*
Fatigue in jaws	0.35*		0.46**
Evaluation of present symptoms	0.32*		0.39**
Previous treatment	0.41**		
Need treatment	0.33*		
Joint pain (clinical)		0.34*	0.46**
Attrition, premolars		−0.33*	
Protrusive contacts (0 = bilat; 1 = unilateral)			−0.35*

*** $p < 0.001$; ** $0.001 < p < 0.01$; * $0.01 < p < 0.05$.

Table 6. Relationships in 48 dental students between the clinical dysfunction index, D_i, and number of occlusal interferences, type of occlusal contacts in laterotrusion to the right, equal patterns of occlusal contacts on both sides, 'ideal' occlusion, and attrition index. Figures denote number of subjects

Degree of dysfunction, D_i	Number of interferences			Type of occlusion: Laterotrusion to the right*			Equal on both sides*			'Ideal'		Attrition index		
	0	1–2	3–5	A	B	C	A	B	C	Yes	No	0–1	2–4	5–8
0	2	13	2	6	5	6	3	3	11	2	15	1	6	10
I	4	16	5	11	7	7	5	6	14	1	24	1	16	8
II + III	1	5	0	2	2	2	1	1	4	0	6	0	4	2
Total	7	34	7	19	14	15	9	10	29	3	45	2	26	20

* A = 'cuspid protection'; B = group function, including a cuspid; C = other types.

Correlations

The anamnestic and clinical dysfunction indices were positively correlated with each other and with the index for present bruxism (Table 5). A_i and D_i were naturally correlated with some signs and symptoms of mandibular dysfunction; only the correlations significant for present bruxism have been included in the table, however. Practically no significant correlations were found between the indices and the dental and occlusal factors recorded in the investigation. The only two reaching a significance level of $p < 0.05$ were negative (Table 5). The relationships between the clinical dysfunction index and some occlusal factors are shown in Table 6. Thus, variables such as number and type of occlusal contacts, RCP-IP relationships, occlusal interferences, singly or collected in an interference index, and degree of attrition for groups of teeth or summed up for the whole dentitions did not seem to influence the degree of reported symptoms or clinically recorded signs of mandibular dysfunction or reported bruxism in this group of individuals.

Discussion

Most of the examination methods used in this investigation have previously been analyzed for intra- and inter-observer variations, which were found to be relatively small (19). It has been stated that the study of occlusal contacts is better performed on casts mounted in an articulator than directly in the mouth (6). However, the few attempts made to compare the consistency of clinical and articulator examination of occlusal contacts have not been able to show significant differences between the methods (12). Therefore, the simpler and less time-consuming clinical method was chosen in this study.

It is always difficult to compare the prevalence of signs and symptoms of mandibular dysfunction found in different samples because of differences in selection of subjects and examination methods and criteria (11). The present findings, however, correspond fairly well with those reported recently for non-patient groups of adolescents and young adults with relatively frequent but mainly mild symptoms and signs (20–25).

The occlusal conditions were extremely varied, and only a few subjects had something close to 'ideal occlusion'. Different contact patterns on the left and right side in laterotrusion were found in about 60%. The cuspids were the commonest teeth in excursive contacts recorded at 3 mm from IP, which is consistent with previous findings in young adults (26). The frequency of non-working side interferences was almost identical with that reported by Ingervall (26). The great variation of occlusal contacts in IP in adults with complete dentitions has recently been reported by Riise (27) who also emphasized the difference between light and hard biting when recording the contacts.

The main finding of this study of a non-patient group of young adults is the lack of statistically significant relationships between any type of occlusal variables recorded and the degree of signs and symptoms of functional disturbances of the masticatory system. This result seems to coincide well with the opinion expressed by Berkowitz et al. (28) in a discussion of normal and ideal occlusion: 'malocclusions could be regarded as normal for they are more commonly found in the population than "normal occlusion", they rarely predispose to dental disease, and in most cases, are not associated with masticatory dysfunction'.

In recent epidemiological studies of large samples a few positive relationships have been found between occlusal interferences and signs and symptoms of mandibular dysfunction. The explanatory value of occlusal interferences for the variation of dysfunction in these studies was small, however (24, 25, 29–31). The inconsistent results of previous studies related to the influence of occlusal factors on function and dysfunction of the masticatory system have been reviewed earlier (32–34).

It is possible also in this material to select a few observations that could be taken as a support for an occlusal etiology in mandibular dysfunction: the only subject with severe dysfunction, D_iIII, had an occlusion characterized by single contacts on posterior

teeth in laterotrusion and less than average number of occlusal contacts in IP (10, compared with a mean value of 12.5); two of three subjects with 'ideal occlusion' had D_i0, and the third had D_iI. The variation of findings is great, however, and no general pattern is discernible (Table 6). In patient series occlusal disturbances of clinical significance might be easier to detect in single patients in whom occlusal therapy seems to be an appropriate treatment (35–37).

The present results support the concept of a multifactorial etiology of mandibular dysfunction, the occlusal factor in general being of minor importance. No specific type of occlusal pattern had any significant influence on signs and symptoms of mandibular dysfunction in this non-patient group of young adults. To make possible further analysis, the same variables as used in this study will be studied in a group of patients with mandibular dysfunction.

References

1. Yemm R. Neurophysiologic studies of temporomandibular joint dysfunction. In: Zarb GA, Carlsson GE. eds. Temporomandibular joint. Function and dysfunction. Copenhagen: Munksgaard, 1979: 215–37.
2. Käyser AF. Shortened dental arches and oral function. J Oral Rehabil 1981; 8: 457–62.
3. Clarke NG. Occlusion and myofascial pain dysfunction: is there a relationship? J Am Dent Assoc 1982; 104: 443–6.
4. Greene CS, Marbach JJ. Epidemiologic studies of mandibular dysfunction: a critical review. J Prosthet Dent 1982; 48: 184–90.
5. Krogh-Poulsen W, Olsson A. Management of the occlusion of the teeth. In: Schwartz L, Chayes CM, eds. Facial pain and mandibular dysfunction. Philadelphia: WB Saunders Co, 1969, 236–80.
6. Posselt U. Physiology of occlusion and rehabilitation. 2nd ed. Oxford: Blackwell Scientific Publications, 1968.
7. Ramfjord SP, Ash MM. Occlusion. 2nd ed. Philadelphia: WB Saunders Co., 1971.
8. Kirveskari P. Anterior guidance in stomatognathic function. Proc Finn Dent Soc 1981; 77: 73–8.
9. Riise C. Rational performance of occlusal adjustment. J Prosthet Dent 1982; 48: 319–27.
10. Dawson PE. Evaluation, diagnosis and treatment of occlusal problems. St Louis: CV Mosby, 1974.
11. Helkimo M. Epidemiological surveys of dysfunction of the masticatory system. In: Zarb GA, Carlsson GE, eds. Temporomandibular joint. Function and dysfunction. Copenhagen: Munksgaard, 1979, 175–92.
12. Janson M. Long-term effects of orthodontic treatment. A functional, cephalometric and clinical study of angle cl. II, div. 1 malocclusion cases. [Thesis]. University of Bergen, 1981.
13. Ingervall B, Carlsson GE. Masticatory muscle activity before and after elimination of balancing side occlusal interference. J Oral Rehabil 1982; 9: 183–92.
14. Carlsson GE, Kopp S, Wedel A. Analysis of background variables in 350 patients with TMJ disorders as reported in self-administered questionnaire. Community Dent Oral Epidemiol 1982; 10: 47–51.
15. Helkimo M. Studies on function and dysfunction of the masticatory system. II. Index for anamnestic and clinical dysfunction and occlusal state. Swed Dent J 1974; 67: 101–21.
16. Carlsson GE, Helkimo M. Funktionell undersökning av tuggapparaten. In: Holst JJ, ed. Nordisk klinisk odontologi. Copenhagen: A/S Forlaget for faglitteratur, 1972, 8-II, 1–12.
17. Siegel S. Non-parametric statistics for the behavioral sciences. McGraw-Hill Book Co. Inc., 1956.
18. Bradley JV. Distribution-free statistical tests. New Jersey: Prentice-Hall Inc. 1968, 68–86.
19. Carlsson GE, Egermark-Eriksson I, Magnusson T. Intra- and inter-observer variation in functional examination of the masticatory system. Swed Dent J 1980; 4: 187–94.
20. Molin C, Carlsson GE, Friling B, Hedegård B. Frequency of symptoms of mandibular dysfunction in young Swedish men. J Oral Rehabil 1976; 3: 9–18.
21. Solberg WK, Woo MW, Houston JB. Prevalence of mandibular dysfunction in young adults. J Am Dent Assoc 1979; 98: 25–34.
22. Heløe B, Heløe LA. Frequency and distribution of myofascial pain-dysfunction syndrome in a population of 25-year-olds. Community Dent Oral Epidemiol 1979; 7: 357–60.
23. Nilner M. Prevalence of functional disturbances and diseases of the stomatognathic system in 15–18 year olds. Swed Dent J 1981; 5: 189–97.
24. Egermark-Eriksson I. Mandibular dysfunction in children and in individuals with dual bite. Swed Dent J 1982; (suppl 10).
25. Mohlin B. Need for orthodontic treatment with special reference to mandibular dysfunction. [Thesis] Faculty of Odontology, University of Gothenburg, Sweden, 1982.
26. Ingervall B. Tooth contacts on the functional and non-functional side in children and young adults. Arch Oral Biol 1972; 17: 191–200.
27. Riise C. A clinical study on the number of occlusal tooth contacts in the intercuspal position at light and hard pressure in adults. J Oral Rehabil 1982; 9: 469–77.
28. Berkowitz BKB, Holland GR, Moxham BJ. A colour atlas & textbook of oral anatomy. London: Wolpe Medical Publ Ltd, 1978, 35.
29. Ingervall B, Mohlin B, Thilander B. Prevalence of symptoms of functional disturbances of the masti-

catory system in Swedish men. J Oral Rehabil 1980; 7: 185–97.
30. Egermark-Eriksson I, Ingervall B, Carlsson GE. The dependence of mandibular dysfunction in children on functional and morphologic malocclusion. Am J Orthod 1983; 83: 187–94.
31. Nilner M. Epidemiology of functional disturbances and diseases in the stomatognathic system. A cross-sectional study of 7–18 year olds from an urban district. Swed Dent J 1983 (suppl. 17).
32. Carlsson GE. Consequences of occlusal interferences. In: Zarb GA, Bergman B, Clayton JA, Mac-Kay HF, eds. Prosthodontic treatment for partially edentulous patients. St Louis: CV Mosby, 1978: 161–70.
33. Laskin DM. Myofascial pain-dysfunction syndrome: etiology. In: Sarnat BG, Laskin DM, eds. The temporomandibular joint. A biological basis for clinical practice. 3rd ed. Springfield: CC Thomas Publ., 1980: 289–99.
34. Carlsson GE, Droukas CB. Dental occlusion and the health of the masticatory system. J Craniomand Pract 1984; 2: 141–7.
35. Egermark-Eriksson I, Ingervall B, Carlsson GE. Tandregulering som behandling av patienter med käkledsbesvär. Tandläkartidningen 1975; 67: 404–13.
36. Ingervall B. Orthodontic treatment in adults with temporomandibular joint dysfunction symptoms. Am J Orthod 1978; 73: 551–9.
37. Magnusson T, Carlsson GE. Occlusal adjustment in patients with persistent or recurrent signs of mandibular dysfunction after stomatognathic treatment. J Prosthet Dent 1983; 49: 706–10.

Received for publication 7 June 1983