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Risk factors for bruxism

A review of the literature from 2007 to 2016

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SUMMARY

The aim of the present study was to summarize the risk factors for bruxism that were identified by a systematic search of the literature published between 2007 and 2016. Depending on the size of the odds ratios (ORs) and the lower limit of the 95% confidence intervals indicated by the reports, four risk categories were differentiated. Among others, emotional stress, consumption of tobacco, alcohol, or coffee, sleep apnea syndrome, and anxiety disorders were recognized as important factors among adults. In children and adolescents, apart from distress, behavioral abnormalities and sleep disturbances predominated.

Knowledge of the identified risk factors may be useful when taking the medical history of bruxing patients. Although many of the described variables cannot be influenced by prophylactic or therapeutic means, we recommend the following patient–centered approach ("SMS therapy"): self–observation, muscle relaxation, stabilization (Michigan) splint.

Introduction

Conceivably the phenomenon of bruxism has always accompanied the history of humankind (Kaidonis et al. 1993; Lange 2013). To the present date jaw clenching and tooth grinding are prevalent in all age groups, social classes, and cultures (Manfredini et al. 2013; Cavallo et al. 2014; Machado et al. 2014; Vieira–Andrade et al. 2014; Progiante et al. 2015; Cavallo et al. 2016). Ten years ago, our research group published in this journal the results of a systematic review summarizing those risk factors known by the middle of June 2007, whose existence in adults, compared to their absence, was associated with a higher risk for the occurrence of bruxism (Kuliš & Türp 2008). In that article we distinguished four grades of severity (A to D) depending on the odds ratio (OR) as well as the lower limit of the 95% confidence interval (CI_{LL}) indicated in the publications. Using this distinction, we classified the chance for the presence of a bruxism–related risk factor as very high (grade A: $OR > 2$; $CI_{LL} > 2$), high (grade B: $OR > 2$; $1 < CI_{LL} \leq 2$), probable (grade C: $1 < OR \leq 2$; $CI_{LL} > 1$), or possible (grade D: $1 < OR \leq 2$; $CI_{LL} \leq 1$).

The OR is a measure for risk assessment. It indicates how much greater the chance is to encounter the interesting phenomenon (e.g., a disease) in a group with a risk factor as compared to a group without this factor. In general, an OR is considered clinically relevant if it is either greater than 2 (interpreted as "harmful") or smaller than 0.5 ("protective") (Gesch 2004). It should be noted that the values of 2 and 0.5 constitute rather a tacit agreement than rationally substantiated boundary limits. However, such a convention is not uncommon. The situation is similar in the case of statistical tests in which the level of significance is commonly set at 5% and confidence intervals (confidence probability) at 95% (Straus et al. 2005).

As regards content the present work continues the publication of the year 2008 insofar as we expand the insights gained

at that time by the literature published until December 31, 2016. In this follow-up study, we are particularly interested in the question whether additional, then still unknown risk factors have appeared. It was our objective to find as many as possible (ideally all) different – already known as well as new – variables described in the professional literature during the predefined period of time. In contrast to the work published in the year 2008, the present search included children and adolescents.

In this article, the word "risk factor" is used as neutral broader term for the two constructs "risk indicator" and "causal risk factor". While a risk indicator points to an elevated disease risk without having itself a causal influence on the development of the disease, a causal risk factor etiologically contributes to an increased disease risk (Faller & Lang 2015).

Materials and Methods

Electronic literature searches were carried out in the following databases (last update on February 17, 2017):

1. PubMed (www.pubmed.gov)
2. Virtual Health Library (bvsalud.org)
3. LIVIVO (www.livivo.de)
4. Google Scholar (scholar.google.de)
5. Japan Medical Abstracts Society (www.jamas.or.jp/index.html)

The searches were aimed at identifying reported findings from epidemiologic studies which had been published between January 1, 2007, and December 31, 2016, in the form of scientific articles. The search in the database "Japan Medical Abstracts Society" was restricted to the time period from 2007 to 2013. The search strategies applied in the selected databases are listed in Table I.

A decisive inclusion criterion were details concerning ORs and 95% confidence intervals; articles without information on ORs and confidence intervals were not taken into account. The obtained hits were verified regarding their relevance. Based on the criteria mentioned above, findings were classified into grades A to D and tabulated.

Results

The search yielded a total of 202 hits (Tab. I), of which the articles listed in Tables II and III remained following a close review. A part of the risk factors in adults known already before 2008 was confirmed by further studies or expanded by details (Tab. II). This concerns the following seven variables: emotional stress; the consumption of stimulants, such as tobacco, alcohol, and coffee; the diseases sleep apnea syndrome and anxiety disorder; age. Newly identified factors associated with bruxism predominantly concern diseases, such as reflux esophagitis, depression, respiratory diseases, or nocturnal frontal lobe epilepsy. Tension,

Tab. I Selected search strategies and outcomes

Database	Search terms	Hits	Relevant hits	Cumulative relevant hits
PubMed Filter: – Publication dates: 2007/01/01 to 2017/02/17 – Species: "Humans"	(risk*[Title/Abstract] OR risk*[MeSH:noexp] OR risk*[MeSH:noexp] OR cohort studies[MeSH Terms] OR group[Text Word] OR groups[Text Word] OR grouped [Text Word]) AND bruxism	478	135	**135**
PubMed – MeSH[1]	(bruxism[MeSH] OR bruxism) AND (Risk[MeSH] OR "Risk Assessment"[MeSH]) AND (("2007/01/01"[PDat] : "2017/02/17"[PDat]) AND Humans[Mesh])	126	47	**5**
PubMed – MeSH[1]	((((("Bruxism"[Mesh]) OR bruxism))) AND (("Odds Ratio"[Mesh] OR odds ratio*) AND ("2007/01/01"[PDat] : "2017/02/17"[PDat]) AND Humans[Mesh])	59	25	**4**
Virtual Health Library	tw:(bruxism*) AND type_of_study:("case_reports" OR "case_control" OR "cohort") AND clinical_aspect:("etiology" OR "prediction") AND limit:("humans") AND year_cluster:("2012" OR "2007" OR "2008" OR "2010" OR "2009" OR "2011" OR "2013" OR "2014" OR "2015" OR "2016" OR "2017")	119	37	**6**
LIVIVO	(bruxism* AND risk*) AND PY=2007:2017	216	66	**8**
	(bruxism* AND etiolog*) AND PY=2007:2017	367	86	**25**
Google Scholar Time period: 2007–2017	(Bruxism AND (risk OR risk factors)) [tiab]	124	3	**2**
Japan Medical Abstracts Society (医中誌Web) (2007–2013)	ブラキシズム リスクファクター リスク 病因 or 病因論	130	21	**17**
			Sum:	**202**

[1] Medical Subject Headings

emotional instability, and attenuated psychotic personality traits are also linked to a higher chance of bruxism. For the first time, a genetic variable was identified.

The risk factors in children and adolescents, among other things, are related to behavioral abnormalities and sleep disorders (Tab. III).

Discussion

The findings of our study demonstrate that apart from the correlation between emotional stress and bruxism, which in the professional literature has been well documented and consistently discussed (Mienna et al. 2014; Wieckiewicz et al. 2014; Karakoulaki et al. 2015; Cavallo et al. 2016), many additional factors can be associated with jaw clenching and tooth grinding. Significantly, no occlusal factor has been identified. By contrast, indications regarding the role of genetic and hereditary influences on bruxism are increasing in the professional literature (Lobbezoo et al. 2014), as is similarly the case with regard to temporomandibular disorders (Smith et al. 2013; Luo et al. 2015; Meloto et al. 2015; Visscher & Lobbezoo 2015).

Tab. II Risk factors for bruxism in adults determined between 2007 and 2016, sorted according to the size of the odds ratios (ORs)

Grade of severity	Variable	Type of study	OR	CI[1]	Source
A	Social phobia (social anxiety disorder)	Case-control study	23.7*	2.9–191.0	(Hermesh et al. 2015)
	Marital status: married	Cross-sectional study	6.9	3.9–12.2	(Alajbeg et al. 2012)
	Emotional stress	Cross-sectional study	5.9*	2.6–13.3	(Quadri et al. 2015)
	Awake bruxism	Cross-sectional study	5.0**	2.6–9.8	(Winocur et al. 2011)
	Sleep bruxism	Cross-sectional study	5.0*	2.5–9.7	(Winocur et al. 2011)
	Regular smoking	Cross-sectional study	2.9**	2.3–3.6	(Rintakoski & Kaprio 2013)
B	Reflux esophagitis	Cross-sectional study	6.6**	1.4–31.0	(Mengatto et al. 2013)
	Nocturnal frontal lobe epilepsy	Case-control study	5.4**	1.3–21.7	(Bisulli et al. 2010)
	Single nucleotide polymorphism (rs6313) in serotonin receptor 5-HT_{2A}	Case-control study	4.3**	1.6–11.3	(Abe et al. 2012)
	Sleep apnea syndrome	Case-control study	4.0**	1.0–15.2	(Hosoya et al. 2014)
	Emotional instability (neuroticism)	Cross-sectional study	2.8	1.4–5.6	(Alajbeg et al. 2012)
	Smoking	Cross-sectional study	2.7	1.7–4.3	(Alajbeg et al. 2012)
	Psychoticism (attenuated psychotic features in healthy individuals)	Cross-sectional study	2.6	1.2–5.7	(Alajbeg et al. 2012)
	Heavy smoking (≥10 cigarettes/day)	Cross-sectional study	2.5 (**)	1.8–3.4	(Rintakoski et al. 2010b)
	Anxiety	Cross-sectional study	2.2	1.3–3.6	(Ahlberg et al. 2013)
C	Female gender	Cross-sectional study	2.0**	1.4–2.7	(Blanco Aguilera et al. 2014)
	Alcohol excesses	Cross-sectional study	1.8	1.4–2.4	(Rintakoski & Kaprio 2013)
	Military service	Cross-sectional study	1.8	>1.0–3.3	(Alajbeg et al. 2012)
	Age between 18 and 60 years (in comparison to >60 years)	Cross-sectional study	1.7	1.2–2.2	(Blanco Aguilera et al. 2014)
	High alcohol consumption (females >7, males >14 drinks/day)	Cross-sectional study	1.7	1.1–2.7	(Rintakoski & Kaprio 2013)
	Daily pipe smoking	Cross-sectional study	1.7	>1.0–2.6	(Rintakoski et al. 2010a)
	Depression	Cross-sectional study	1.6**	1.3–2.0	(Nakata et al. 2008)
	High coffee consumption (>8 cups/day)	Cross-sectional study	1.4	>1.0–2.0	(Rintakoski & Kaprio 2013)
	Nausea and tendency for gagging during dental care	Cross-sectional study	1.2**	1.1–1.3	(Winocur et al. 2011)
	Nausea and tendency for gagging during dental care	Cross-sectional study	1.1*	>1.0–1.2	(Winocur et al. 2011)
D	Chewing of khat (qat)	Cross-sectional study	1.6*	0.4–7.4	(Quadri et al. 2015)

[1] CI: 95% confidence interval * Awake bruxism ** Sleep bruxism

Knowledge of the identified risk factors can be helpful when taking the medical history of bruxism patients. The contents of Tables II and III emphasize that the common focusing on and reduction of the causes of tooth grinding and/or jaw clenching to emotional stress fall short. In addition, usually not only one, but rather several variables will exert an influence on these parafunctions.

A great part of the described risk factors is not or only to a limited extent amenable to therapy. This concerns the listed diseases as well as emotional stress (Carra et al. 2015; Manfredini et al. 2015; Yap & Chua 2016). Bad habits, such as smoking and high alcohol consumption, are in principle more accessible to a change; however, such a request often fails because of the individual living conditions. In contrast, significantly better to affect are factors such as sleeping with light, noise in the children's room, high media consumption, and adverse dietary habits, which have been identified as risks of bruxism in children.

Considering the potential negative consequences of persistent bruxism on dental and oral health, a therapeutic nihilism

Tab. III Risk factors for bruxism in children and adolescents determined between 2007 and 2016, sorted according to the size of the odds ratios (ORs)

Grade of severity	Variable	Type of study	OR	CI[1]	Source
A	Mental disorders, e.g. thought disorders, disorders in social behavior, dissocial personality disorders (in 12- to 14-year-old girls)	Case-control study	16.6	4.0–68.0	(Katayoun et al. 2008)
	ADHS (in 11- to 17-year-old children and adolescents)	Case-control study	4.3**	2.6–7.0	(Gau & Chiang 2009)
	Problems with falling asleep (in 4- to 16-year-old children and adolescents)	Cross-sectional study	4.1(**)	2.5–6.6	(Gonçalves et al. 2009)
	Problem behavior (in 12- to 15-year old children and adolescents)	Cross-sectional study	3.3**	2.3–4.7	(Sakaguchi et al. 2014)
	Somniloquy (in 4- to 16-year-old children and adolescents)	Cross-sectional study	3.0 (**)	2.1–4.3	(Gonçalves et al. 2009)
B	Barbiturates in 2- to 18-year-old children and adolescents with infantile cerebral palsy	Cross-sectional study	11.0**	1.4–88.0	(Ortega et al. 2014)
	Bad night's sleep (in 7- to 10-year-old children)	Case-control study	3.3**	1.6–6.6	(Serra-Negra et al. 2014)
	Media consumption (in schoolchildren)	Cross-sectional study	2.8	1.5–5.0	(Suwa et al. 2009)
	Bruxism in the family (in 4- to 16-year-old children and adolescents)	Cross-sectional study	2.7 (**)	1.9–3.8	(Gonçalves et al. 2009)
	Noise in the children's room (in 7- to 10-year-old children)	Case-control study	2.7	1.6–4.4	(Serra-Negra et al. 2014)
	ADHS, combined type (in 10- to 17-year-old children and adolescents)	Cross-sectional study	2.6**	1.7–3.9	(Chiang et al. 2010)
	ADHS with hyperactivity impulsiveness (in 10- to 17-year-old children and adolescents)	Cross-sectional study	2.6**	1.0–6.6	(Chiang et al. 2010)
	Headache (in 4- to 16-year-old children and adolescents)	Cross-sectional study	2.6 (**)	1.6–4.2	(Gonçalves et al. 2009)
	Nightly sleep duration ≤8 hours (in 7- to 10-year-old children)	Case-control study	2.6**	1.5–4.4	(Serra-Negra et al. 2014)
	Sleeping with light (in 7- to 10-year-old children)	Case-control study	2.4**	1.4–3.9	(Serra-Negra et al. 2014)
	Grinding of teeth at daytime (in 8-year-old children)	Case-control study	2.3**	1.2–4.3	(Serra-Negra et al. 2012a)
	Pronounced sense of responsibility (in 7- to 11-year-old children)	Cross-sectional study	2.2	1.0–5.0	(Serra-Negra et al. 2009)

[1] CI: 95% confidence interval * Awake bruxism ** Sleep bruxism

Tab. III Risk factors for bruxism in children and adolescents determined between 2007 and 2016, sorted according to the size of the odds ratios (ORs) continued

Grade of severity	Variable	Type of study	OR	CI[1]	Source
C	ADHS with inattention (in 10- to 17-year-old children and adolescents)	Cross-sectional study	2.0**	1.2–3.1	(Chiang et al. 2010)
	Pronounced neuroticism (in 7- to 10-year-old children)	Cross-sectional study	1.9	1.3–2.6	(Serra-Negra et al. 2009)
	Depressive mood (in 12- to 17-year-old children and adolescents)	Cross-sectional study	1.8*	1.4–2.4	(van Selms et al. 2013)
	Emotional stress (in 7- to 11-year-old children)	Case-control study	1.8	1.1–2.9	(Serra-Negra et al. 2012b)
	Bad dietary habits (in schoolchildren)	Cross-sectional study	1.8	1.1–3.1	(Suwa et al. 2009)
	ADHS-treatment using methylphenidate	Case-control study	1.7	1.0–2.7	(Gau & Chiang 2009)
	Tension (in 4- to 16-year-old children and adolescents)	Cross-sectional study	1.6 (**)	1.1–2.2	(Gonçalves et al. 2009)
	Female gender (in 12- to 17-year-old children and adolescents)	Cross-sectional study	1.5**	1.2–1.8	(van Selms et al. 2013)
	Depressive mood (in 12- to 17-year-old children and adolescents)	Cross-sectional study	1.4**	1.1–1.7	(van Selms et al. 2013)
	Smoking (in 12- to 17-year-old children and adolescents)	Cross-sectional study	1.4*	1.1–1.9	(van Selms et al. 2013)
	Emotional stress (in 12- to 17-year-old children and adolescents)	Cross-sectional study	1.4*	1.0–1.8	(van Selms et al. 2013)
	Respiratory diseases (in 4- to 16-year-old children and adolescents)	Cross-sectional study	1.4 (**)	1.0–2.0	(Gonçalves et al. 2009)
D	Pronounced sense of responsibility (in 7- to 11-year-old children)	Case-control study	1.6	1.0–2.5	(Serra-Negra et al. 2012b)
	Emotional stress (in 12- to 17-year-old children and adolescents)	Cross-sectional study	1.3**	1.0–1.6	(van Selms et al. 2013)

[1] CI: 95% confidence interval * Awake bruxism ** Sleep bruxism

nevertheless does not seem advisable to us. Rather, in cases of established bruxism due to any etiology we recommend the following reversible procedure ("SMS therapy"), which is at least partly covered by scientific evidence (Ommerborn et al. 2007; Trindade et al. 2015):

1. **S**elf-observation. Goal: Bringing to awareness of clenching or grinding activities during waking hours. Implementation: Colored stickers (e.g., orange-colored dots) are attached in places, where in the course of the day one looks occasionally and rather accidentally (e.g., the telephone, purse, cupboard, mirror); at the moment of catching sight one shall ask oneself whether the teeth are in contact or one is even clenching or grinding.
2. **M**uscle relaxation. Goal: By learning and daily performing of a relaxation technique, a "muscular and vegetative stabilization" and, as a consequence thereof, an improved body perception and stress management (among other things) are to be achieved (Diezemann 2011). Implementation: Suitable and established techniques are imagination, autogenic training, and progressive muscle relaxation. The last-mentioned method is by far the most frequently applied relaxation procedure (Diezemann 2011). Admittedly, the findings from a four-week follow-up study could not ascertain an effect of progressive muscle relaxation on sleep bruxism (Valiente López et al. 2015); also thus far there are no results regarding the impact of this method on awake bruxism. Nevertheless, we keep to relaxation procedures, because bruxism constitutes a very strong risk factor for temporomandibular pain (Carlsson et al. 2002; Michelotti et al. 2010; Sierwald et al. 2015), and particularly the progressive muscle relaxation is a provably useful and, therefore, often performed therapeutic method in pain therapy (Diezemann 2011), particularly in cases of tension-type headache, migraine, and back pain (Lüking & Martin 2017), but also in cases of orofacial pain (Aggarwal et al. 2011).
3. **S**plint therapy. Goal: Protection of the tooth structures from attrition (and conceivably abfraction), protection of possible dental reconstructions from damage, protection of oral structures (periodontium, jaw bone, masticatory musculature) from overload. Implementation: Wearing of an oral appliance (preferably the Michigan splint) during sleep.

Résumé

Cet article a pour objet de compiler les différents facteurs de risques de bruxisme, et d'en faire la synthèse en s'appuyant sur une recherche systématique parmi les publications scientifiques parues de 2007 à 2016 sur le sujet. En tenant compte de l'odds ratio et de l'estimation basse de l'intervalle de confiance (95%), quatre catégories de risques ont été distinguées.

Chez l'adulte furent identifiées parmi les principaux facteurs de risques: le stress psychologique, la consommation de tabac, d'alcool ou de caféine, le syndrome d'apnée du sommeil et les troubles anxieux; alors que chez l'enfant et l'adolescent, ce sont les troubles du comportement et du sommeil qui dominaient avant tout.

Pour le praticien, connaître et identifier les facteurs de risques dans le cadre de l'anamnèse du patient bruxeur peut être instructif. Cependant on ne peut intervenir prophylactiquement ni thérapeutiquement dans une grande partie des facteurs décrits. Nous recommandons une approche centrée autour du patient: observation personnelle, détente musculaire et attelle de Michigan.

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