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Can one predict the likely specific orofacial pain syndrome from a self-completed questionnaire?

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Abstract

To estimate the prevalence of orofacial pain (OFP) by specific diagnostic subgroups in the general population. Cross-sectional population study. General medical practice in South East Cheshire, UK. Participants of baseline investigation who completed the full postal questionnaire (1510, adjusted study participation rate 81%). Clinical examination was attended by 126 (43%) of all the participants who reported OFP in the questionnaire. These individuals were classified as musculoligamentous/soft tissue type, dentoalveolar or neurological/vascular. OFP duration, location, descriptors and statements on OFP were predictors of classification group. The estimated prevalence in the general population of musculoligamentous/soft tissue type of OFP was 7%, dentoalveolar 7% and neurological/vascular 6%. This study has derived a statistical model to classify participants with OFP into three broad groups (musculoligamentous/soft tissue, dentoalveolar and neurological/vascular) based on questionnaire information about OFP (OFP chronicity, location and verbal descriptors of pain). It is potentially useful in large population studies of OFP, where a clinical examination is not possible, however, further validation of its performance in large populations are necessary.

Keywords: Orofacial pain; Prevalence; General population; Pain diagnosis

1. Introduction

The term orofacial pain (OFP) can be separated into two parts: oral and facial. While oral pain indicates pain within the mouth, facial pain includes pain that originates below the orbitomeatal line and above the neck and anterior to the ears (Zakrzewska and Hamlyn, 1999). The majority of OFP is acute in nature and is due to dental caries and its sequelae, toothache. The remainder, apart from trauma, is considered chronic OFP. Approximately a quarter of the participants in a large population-based study of OFP reported having pain during 4 weeks prior to an investigation, so it is a relatively common problem (Macfarlane et al., 2002). However, OFP is a heterogeneous set of conditions, which may have distinct aetiological factors. Patients with self-reported OFP may have a diagnosis of toothache, temporomandibular disorder, sinusitis or trigeminal neuralgia, and there are many other possible diagnoses. When studying the epidemiology of OFP in large population samples, the most common approach is to collect information on both OFP and possible aetiological factors by means of a questionnaire. Clinical examination in the general population is not always possible and involves considerable resources. A frequent criticism of such a questionnaire-based method is that all types of OFP are grouped together. One solution to the problem would be to devise a set of questions that can discriminate between the different types of OFP.

Previous studies (Hapak et al., 1994; Hunter, 1983; Jerome et al., 1988; LeResche et al., 1991; Melzack et al.,

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1986) have attempted to devise questionnaires to differentiate between clinical entities. However, none are suitable for use in large-scale population studies as they did not offer a clinical examination to validate the questionnaire findings.

The aim of this study was to devise and validate an algorithm to discriminate between different types of OFP, to be used in large-scale population-based epidemiological studies.

2. Methods

2.1. Study design and sample

The baseline study, conducted in 1997–1998, comprised 2504 participants aged 18–65 years registered with a general medical practice in South East Cheshire, North West England (Macfarlane et al., 2002). The adjusted participation rate was 74%, after exclusion of those that had moved and non-eligible subjects. Participants in the baseline survey were sent a follow up questionnaire 4 years later. Non-respondents to the first follow up questionnaire were sent a reminder postcard, followed by a further questionnaire in case of non-response and, finally, a short version of the study questionnaire.

All the participants were asked to give permission to be contacted further and provide a contact telephone number.

Ethical approval for the follow up study was granted by South Cheshire local research ethics committee, which comes under the responsibility of the local Health Authority.

2.2. Questionnaire

The questionnaire was 10 pages and consisted of questions on socio-demographic factors, pain and psychological distress. The principal question concerning OFP asked whether participants 'have had any pain in their face, mouth or jaws that has lasted for one day or longer' during the past month. Those answering positively to this question were asked further questions about pain severity (on scale 0–10), pain duration, pain location (using face manikins), verbal descriptors of pain based on the short McGill pain questionnaire (Melzack, 1987) (12 questions) and statements about OFP, modified from a questionnaire previously developed by Hapak et al. (1994) (17 questions). People who reported OFP were also asked whether they took time off work, were unable to carry out usual activities and whether they sought professional help.

Psychological distress was measured using the 12-item version of the General Health Questionnaire (GHQ) (Goldberg and Williams, 1988). Each item within the questionnaire consists of asking the subjects whether they have recently (during the past few weeks) experienced a particular symptom, on a 4-point Likert scale. Each item was reduced to a dichotomy of symptom present/absent to provide a total score between 0 and 12, with higher scores indicating higher levels of distress.

2.3. Clinical examination

Participants, who answered positively to having OFP during the past month and gave permission to be contacted further, were invited to a clinical examination by one of two clinical examiners (VA and RC). The initial invitation letter was sent by post and followed by a telephone call. The examination closing date was 21/03/2002, and no more participants were invited to clinical examination after this date. The clinical examination was conducted either at the GP practice, local dental practice or, in one case, in the participant's home. Both clinical examiners used a standard history and clinical examination form (Zakrzewska, 2002) which had been piloted with one of the clinical examiners (VA) who was also observed while using it by a senior facial pain specialist, and who then trained the second clinical examiner (RC). The diagnostic criteria for the different conditions were those proposed by the IASP (Merskey and Bogduk, 1994). The standard form from each clinical examination was then forwarded to three clinical experts in oral medicine (JZ, PA and ME) who used these forms as standard in their practice, to independently diagnose the participants. They were

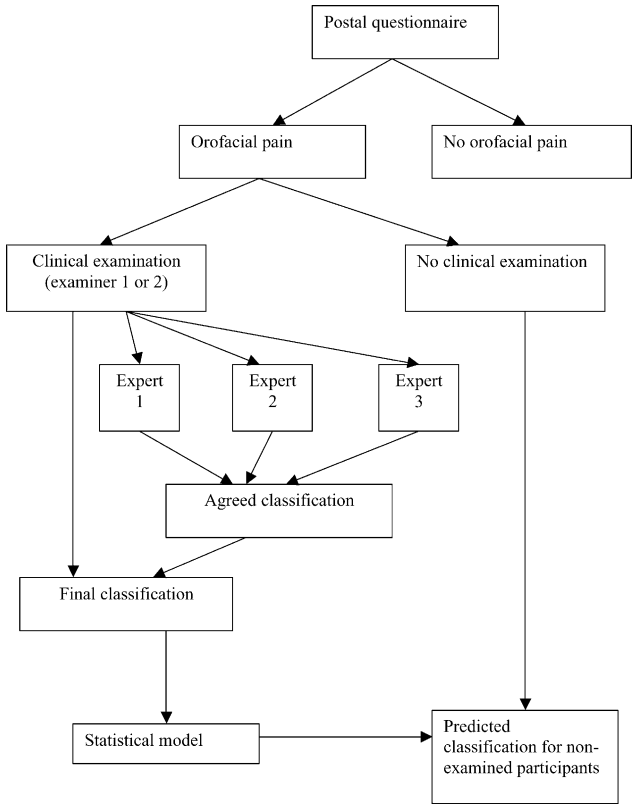

Fig. 1. Study design.

unaware of the diagnosis given by the clinical examiner and they did not have access to the self-complete questionnaire. In cases of disagreement between the three clinical experts, these were discussed at a consensus meeting, where diagnosis was agreed. The agreed clinical expert diagnosis was then compared with the diagnosis of the clinical examiners (Fig. 1). In the event of disagreement at this later stage the case was discussed at a further meeting (JZ, VA and RC) where the final diagnosis was agreed. The final diagnoses were then aggregated into one of three broad groups: musculoligamentous/soft tissue, dentoalveolar, and neurological/vascular, based on a modification of the classification suggested by Hapak et al. (1994) (Table 1).

2.4. Statistical methods

Statistical analysis was performed using the STATA statistical package (StataCorp, 2001). The first aim of the statistical analysis was to try to predict, based on questionnaire data, the final agreed clinical classification group for clinically examined participants with OFP. Initially, univariate analysis was conducted comparing between each two out of three clinical classification groups using, where appropriate, chi-square or Fisher exact test. Variables with P-value <0.1 for at least one comparison between any two out of three groups were selected for the initial statistical model. The statistical model was maximum-likelihood multinomial (polytomous) logistic regression. This model is used when the dependent variable (classification group in this case) takes on more than two outcomes, and the outcomes have no natural ordering. From the initial statistical model, stepwise backward procedure was used to determine the most parsimonious model. Based of this final model, a person with OFP was then allocated to a predicted broad group with the highest out of the three probabilities for each classification group (Fig. 1).

The Kappa statistic (Fleiss, 1981) was used to assess agreement between the clinical examiner and clinical experts.

Table 1
Distribution of examined participants by specific diagnosis and classification group

Diagnosis	*N* (%)
Musculoligamentous/soft tissue	49 (39.2)
TMD pain	23 (18.4)
Chronic idiopathic facial pain	15 (12.0)
Salivary gland disease	4 (3.2)
Oral mucosal disease	4 (3.2)
Myofascial pain	1 (0.8)
Burning mouth syndrome	1 (0.8)
Soft tissue trauma	1 (0.8)
Dentoalveolar	41 (32.8)
Dental abcesses	12 (9.6)
Sinusitis	11 (8.8)
Pulpal	11 (8.8)
Dentinal	4 (3.2)
Pericoronitis	2 (1.6)
Cracked tooth syndrome	1 (0.8)
Neurological/vascular	35 (28.0)
Chronic tension headaches	14 (11.2)
Migraine	10 (8.0)
Pre-trigeminal neuralgia	2 (1.6)
Unknown neurological pain	2 (1.6)
Nerve damage	2 (1.6)
Glossopharyngeal neuralgia	1 (0.8)
Post herpetic neuralgia	1 (0.8)
Temporal arteritis	1 (0.8)
Superior laryngeal neuralgia	1 (0.8)
Iritis	1 (0.8)
Total	125 (100)

3. Results

3.1. Participation rate

A total of 1680 persons participated at follow up, giving an adjusted participation rate of 81% (after excluding those who were no longer registered with the practice ($n=394$), deceased or who were not able to complete the questionnaire due to illness or disability ($n=21$) or expressed a wish at baseline not to be contacted again ($n=3$)). The full study questionnaire was completed by 1510 participants (90% of all who participated).

3.2. Orofacial pain

Of those who completed the full questionnaire, 295 reported OFP (prevalence 19%), 1202 (80%) did not report such pain and 13 (1%) did not answer this question. The majority of the questionnaires from participants with OFP were received prior to the examination closing date (290, 98%) and of those 217 (75%) agreed to be contacted again. Finally, 126 (43%) of all the participants with OFP attended the clinical examination. The reasons for non-attendance were: not possible to establish contact e.g. no telephone number available; telephone number wrong or unobtainable; no answer or answering machine ($n=48$); refused ($n=27$); no suitable date could be arranged ($n=12$); did not turn up to examination ($n=3$) and cancelled appointment ($n=1$). The median time between completion of the questionnaire and clinical examination was 40 days, interquartile range (IQR) 25–68 days. There were significantly more women (77 versus 62%) (χ^2 test $P=0.006$) and older participants (59% age over 50 years versus 43%) (χ^2 test $P=0.005$) among examined compared to non-examined participants. There was no statistically significant difference between examined and non-examined participants in time since OFP onset (χ^2 test $P=0.106$) and severity of OFP (Mann–Whitney U test $P=0.425$).

Table 2
Comparison of pain duration, severity and pain location between classification groups

OFP characteristics	Musculoligamentous/ soft tissue *N* (%) (1)	Dentoalveolar *N* (%) (2)	Neurological/vascular *N* (%) (3)	χ^2 test
OFP for more than 3 months	38 (77.5)	20 (48.8)	26 (74.3)	1v2 $P=0.005$; 1v3 $P=0.729$; 2v3 $P=0.023$
Level of pain scale: 0 (no pain)–10 (pain as bad as it could be) median (IQR)	4 (4–6)	4 (3–6)	5 (3–6)	Mann-Whitney test; 1v2 $P=0.658$; 1v3 $P=0.737$; 2v3 $P=0.541$
Pain location				
Eye, temple and half-forehead on one side	8 (16.3)	4 (9.8)	10 (28.6)	–
Eyes, temples and forehead on both sides	9 (18.4)	6 (14.6)	16 (45.7)	
Middle face on one side	4 (8.2)	4 (9.8)	1 (2.9)	
Middle face on both sides	2 (4.1)	2 (4.9)	1 (2.9)	
Lower face on one side	6 (12.2)	6 (14.6)	2 (5.7)	
Lower face on both sides	4 (8.2)	0 (0)	0 (0)	
Side of the face	7 (14.3)	1 (2.4)	3 (8.6)	
Maximum pain is elsewhere	4 (8.2)	3 (7.3)	1 (2.9)	
Maximum pain is in the mouth	5 (10.2)	15 (36.6)	1 (2.9)	
Laterality				
Unilateral	29 (59.2)	28 (68.3)	16 (45.7)	1v2 $P=0.372$; 1v3 $P=0.222$; 2v3 $P=0.047$
Bilateral	20 (40.8)	13 (31.7)	19 (54.3)	
Site				
Above orbitomeatal line	17 (34.7)	10 (24.4)	27 (77.1)	1v2 $P=0.288$; 1v3 $P<0.001$; 2v3 $P<0.001$
Below orbitomeatal line	32 (65.3)	31 (75.6)	8 (22.7)	
Pain in the mouth area	5 (10.2)	15 (36.6)	1 (2.9)	1v2 $P=0.003$; 1v3 $P=0.197$; 2v3 $P=0.001$

3.3. Specific diagnosis of OFP

There was substantial agreement in OFP classification between the three clinical experts (kappa = 0.78) who reviewed the clinical pro-formas. When consensus between the clinical experts was compared to classification made by clinical examiners, the level of agreement was also high (kappa = 0.80). Classification and specific diagnoses are presented in Table 1. One participant who reported OFP in the questionnaire did not have an OFP condition at examination, and therefore was classified in the non-examined group. The most common group of conditions was having pain of musculoligamentous/soft tissue origin (49, 39%), followed by dentoalveolar (41, 33%) and neurological/vascular (35, 28%) conditions. In the musculoligamentous/soft tissue group the most common diagnoses were temporomandibular disorder pain (23, 18% of total examined participants) and chronic idiopathic facial pain (15, 12% of total examined participants). In the dentoalveolar group, the most common diagnoses were periodontal disease (14, 11% of total examined participants), sinusitis (11, 9% of total examined participants) and pulpitis (11, 9% of total examined participants). In the neurological/vascular group, the most common diagnoses were chronic tension headache (14, 11% of total examined participants) and migraine (10, 8% of total examined participants).

3.4. Comparison of orofacial pain characteristics between classification groups

Overall, there was a variation in both the characteristics of the pain and its descriptors between the three clinical classification groups.

Tables 2–4 show the comparison of OFP duration, severity, location, descriptors and statements between classification groups for clinically examined participants. The dentoalveolar group was less likely to report having pain for more than 3 months (50%) than musculoligamentous/soft tissue group (77%) ($P=0.005$), and were more likely to shade the picture of the mouth when describing pain location (37%) compared to the musculoligamentous/soft tissue (10%) and neurological/vascular (3%) group ($P<0.004$). The dentoalveolar group was more likely to report that their OFP arose from one or more teeth (63%) in comparison to the musculoligamentous/soft tissue (12%) and neurological/vascular (6%) groups ($P<0.001$). They were also more likely to report that their OFP started when cold/warm things were eaten/drunk (29%) in comparison to musculoligamentous/soft tissue and neurological/vascular (6 and 3%, respectively) groups ($P<0.005$), and were less likely to report that their OFP worsened when tired or stressed (17%) than the neurological/vascular group (46%) ($P=0.007$). The neurological/vascular group was more likely to report pain location in the upper part of the face (77%) ($P<0.001$).

Table 3
Comparison of pain descriptors between classification groups

OFP description	MLST *N* (%) (1)	Dentoalveolar *N* (%) (2)	NEU/V *N* (%) (3)	χ^2 test or Fisher exact test
Nagging	15 (30.6)	10 (24.4)	8 (22.9)	1v2 $P=0.512$; 1v3 $P=0.432$; 2v3 $P=0.875$
Aching	23 (46.9)	18 (43.9)	18 (51.4)	1v2 $P=0.773$; 1v3 $P=0.685$; 2v3 $P=0.512$;
Throbbing	9 (18.4)	13 (31.7)	13 (37.1)	1v2 $P=0.142$; 1v3 $P=0.054$; 2v3 $P=0.619$
Sharp	9 (18.4)	8 (19.5)	3 (8.6)	1v2 $P=0.890$; 1v3 $P=0.206$; 2v3 $P=0.177$
Shooting	6 (12.2)	4 (9.8)	4 (11.4)	1v2 $P=0.708$; 1v3 $P=0.909$; 2v3 $P=0.813$
Stabbing	8 (16.3)	4 (9.8)	5 (14.3)	1v2 $P=0.361$; 1v3 $P=0.799$; 2v3 $P=0.542$
Dull	13 (26.5)	10 (24.4)	9 (25.7)	1v2 $P=0.817$; 1v3 $P=0.933$; 2v3 $P=0.894$
Burning	3 (6.1)	0 (0)	1 (2.9)	1v2 $P=0.248$; 1v3 $P=0.637$; 2v3 $P=0.461$
Fearful	0 (0)	1 (2.4)	1 (2.9)	1v2 $P=0.456$; 1v3 $P=0.417$; 2v3 $P=1.00$
Miserable	13 (26.5)	6 (14.6)	11 (31.4)	1v2 $P=0.168$; 1v3 $P=0.624$; 2v3 $P=0.080$
Tugging	1 (2.0)	1 (2.4)	1 (2.9)	1v2 $P=1.00$; 1v3 $P=1.00$; 2v3 $P=1.00$
Pressing	3 (6.1)	2 (4.9)	6 (17.1)	1v2 $P=1.00$; 1v3 $P=0.154$; 2v3 $P=0.133$

Patients were asked to tick the words or word that described their main pain. OFP, orofacial pain; MLST, musculoligamentous/soft tissue (1); NEU/V, neurological/vascular.

Table 4
Comparison of pain statements on orofacial pain between classification groups

OFP statements My pain…	MLST *N* (%) (1)	Dentoalveolar *N* (%) (2)	NEU/V *N* (%) (3)	χ^2 test or Fisher exact test where appropriate
is constant without any pain free intervals	3 (6.1)	5 (12.2)	1 (2.9)	1v2 $P=0.461$; 1v3 $P=0.637$; 2v3 $P=0.209$
occurs intermittently in a non-predictable pattern with pain-free intervals	20 (40.8)	12 (29.3)	21 (60.0)	1v2 $P=0.254$; 1v3 $P=0.083$; 2v3 $P=0.007$
comes in clusters, everyday for several days or weeks, with pain free intervals	6 (12.2)	3 (7.3)	4 (11.4)	1v2 $P=0.502$; 1v3 $P=1.00$; 2v3 $P=0.697$
is getting worse over time	3 (6.1)	3 (7.3)	2 (5.7)	1v2 $P=1.00$; 1v3 $P=1.00$; 2v3 $P=1.00$
is located externally on my skin	1 (2.0)	1 (2.4)	0 (0)	1v2 $P=1.00$; 1v3 $P=1.00$; 2v3 $P=1.00$
arises from my tooth/teeth	6 (12.2)	26 (63.4)	2 (5.7)	1v2 $P<0.001$; 1v3 $P=0.315$; 2v3 $P<0.001$
is only on ONE side of my head or face and is always on the same side	20 (40.8)	11 (26.8)	12 (34.3)	1v2 $P=0.164$; 1v3 $P=0.543$; 2v3 $P=0.481$
is sometimes on one side and sometimes on the other side at different times	8 (16.3)	4 (9.8)	11 (31.4)	1v2 $P=0.361$; 1v3 $P=0.103$; 2v3 $P=0.018$
is on BOTH sides of my head or face at the SAME time	13 (26.5)	5 (12.2)	9 (25.7)	1v2 $P=0.090$; 1v3 $P=0.933$; 2v3 $P=0.130$
starts when I lightly touch my face	2 (4.1)	0 (0)	2 (5.7)	1v2 $P=0.498$; 1v3 $P=1.00$; 2v3 $P=0.209$
starts when I drink/eat cold or warm things	3 (6.1)	12 (29.3)	1 (2.9)	1v2 $P=0.004$; 1v3 $P=0.637$; 2v3 $P=0.002$
gets worse when I am tired or stressed	17 (34.7)	7 (17.1)	16 (45.7)	1v2 $P=0.060$; 1v3 $P=0.308$; 2v3 $P=0.007$
gets worse the more I move my jaw when eating, chewing and/or talking	9 (18.4)	6 (14.7)	1 (2.9)	1v2 $P=0.779$; 1v3 $P=0.040$; 2v3 $P=0.077$
gets worse when I bend my head forwards to my knees	5 (10.2)	3 (7.3)	7 (20.0)	1v2 $P=0.723$; 1v3 $P=0.224$; 2v3 $P=0.103$
is better when I apply heat/cold to my face	1 (2.0)	2 (4.9)	3 (8.6)	1v2 $P=0.590$; 1v3 $P=0.303$; 2v3 $P=0.657$
is associated with a running nose	3 (6.1)	1 (2.4)	0 (0)	1v2 $P=0.623$; 1v3 $P=0.262$; 2v3 $P=1.00$
is associated with red/watery eyes	0 (0)	2 (4.9)	2 (5.7)	1v2 $P=0.205$; 1v3 $P=0.171$; 2v3 $P=1.00$
starts when I open the mouth wide	13 (26.5)	3 (7.3)	1 (2.9)	1v2 $P=0.018$; 1v3 $P=0.006$; 2v3 $P=0.620$
starts when I chew food	11 (22.5)	8 (19.5)	2 (5.7)	1v2 $P=0.734$; 1v3 $P=0.037$; 2v3 $P=0.097$

OFP, orofacial pain; MLST, musculoligamentous/soft tissue (1); NEU/V, neurological/vascular.

Table 5
OFP duration, location, descriptors and statements that distinguish musculoligamentous/soft tissue, dentoalveolar and neurological/vascular conditions for examined participants ($n=125$)

OFP	RR (95% confidence interval)[a]		
	Musculoligamentous/soft tissue	Dentoalveolar *N* (%)	Neurological/vascular *N* (%)
Duration: OFP for more than 3 months	1.00	0.24 (0.08, 0.76)	0.64 (0.20, 2.05)
Location: below orbitomeatal line	1.00	0.90 (0.25, 3.24)	0.14 (0.05, 0.44)
Descriptor: throbbing	1.00	3.75 (1.01–13.94)	1.69 (0.55, 5.24)
Descriptor: miserable	1.00	0.16 (0.04, 0.75)	1.02 (0.34, 3.04)
Statement: occurs intermittently in a non-predictable pattern with pain-free intervals	1.00	0.74 (0.24, 2.32)	3.11 (1.11, 8.66)
Statement: my pain arises from my tooth/teeth	1.00	21.73 (5.81, 81.34)	0.85 (0.14, 5.17)

[a] RR, for example, of 21.73 for dentoalveolar group means that risk for statement "My pain arises from my tooth/teeth" is 21.73 times higher in dentoalveolar group compared to musculoligamentous/soft tissue group.

The musculoligamentous/soft tissue group was more likely to report that their OFP started when they opened their mouth wide (27%) than dentoalveolar (7%) and neurological/vascular group (3%) ($P<0.019$).

3.5. Predicting classification for non-examined participants

From univariate analysis as described above, 14 variables were initially entered into the model, and the following six variables remained in the final model (Table 5) after a stepwise backward procedure: OFP for more than 3 months; pain location (below orbitomeatal line); pain described as 'throbbing'; pain described as 'miserable'; pain occurring intermittently in a non-predictable pattern with pain-free intervals; pain arising from teeth. Table 6 shows the comparison of observed and predicted classification group for those subjects that were examined. There was moderate agreement between the observed and predicted classification (kappa=0.5). The highest sensitivity was observed for the musculoligamentous/soft tissue group and dentoalveolar group (71%) while for neurological/vascular group the sensitivity was lower (57%). The specificity for each group was 72, 92 and 86% respectively. From the above final statistical model, the algorithm for classifying the participants based on questionnaire data is presented in Appendix A.

Most of the 170 non-examined participants (70, 41%) were classified into the musculoligamentous/soft tissue group, followed by dentoalveolar (50, 29%) and neurological/vascular (50, 29%) groups. Hence, after combining with the classification for observed data, the estimated prevalence in this population sample was as follows: musculoligamentous/soft tissue 8%, dentoalveolar 6% and neurological/vascular 6%.

A comparison was made of treatment seeking behaviour and disability between the three classification groups for all participants with OFP (examination classification was used for examined participants and predicted from the model for non-examined) (Table 7). Overall, the neurological/vascular group was less likely to seek professional help ($P<0.004$). The dentoalveolar group was more likely to seek advice from a dentist, but less likely to seek advice from their medical practitioner or hospital consultant than the musculoligamentous/soft tissue and neurological/vascular groups ($P<0.02$). Significantly more disability associated with OFP was reported by the neurological/vascular group ($P<0.001$) compared to the other groups. Dentoalveolar group showed lower level of psychological distress (42%) than musculoligamentous/soft tissue group (52%) and neurological/vascular group (51%), however this difference was not statistically significant (Table 7).

When a comparison was made of treatment seeking and disability for OFP between clinically examined and not examined participants within each classification group, the only significant difference was found for musculoligamentous/soft tissue group ($P=0.006$), with examined participants more than twice as likely to have sought advice from dentist (Table 7).

Table 6
Comparison of observed and predicted classification group for subjects undergoing examination ($n=125$)

Classification group predicted from statistical model	Classification group determined from clinical examination		
	Musculoligamentous/soft tissue 49 (39%)	Dentoalveolar 41 (33%)	Neurological/vascular 35 (28%)
Musculoligamentous/soft tissue 56 (45%)	35 (71%)	9 (22%)	12 (34%)
Dentoalveolar 36 (29%)	4 (8%)	29 (71%)	3 (9%)
Neurological/vascular 33 (26%)	10 (20%)	3 (7%)	20 (57%)

Table 7
Comparison of treatment seeking behaviour and disability between classification groups (whole sample with OFP, $n=295$)

OFP characteristics	Musculoligamentous/soft tissue *N* (%)	Dentoalveolar *N* (%)	Neurological/vascular *N* (%)
Professional advice sought			
Examined	37 (75.5)	30 (73.2)	18 (51.4)
Not examined	42 (60.0)	36 (72.0)	21 (42.0)
Overall	79 (66.4)	66 (72.5)	39 (45.9)
Advice sought from dentist			
Examined	22 (44.9)	24 (58.5)	3 (8.6)
Not examined	15 (21.4)	32 (64.0)	4 (8.0)
Overall	37 (31.1)	56 (61.5)	7 (8.2)
Advice sought from general medical practitioner (GP)			
Examined	22 (44.9)	10 (24.4)	10 (28.6)
Not examined	31 (44.3)	6 (12.0)	18 (36.0)
Overall	53 (44.5)	16 (17.6)	28 (32.9)
Had to take time off because of OFP			
Examined	10 (20.4)	7 (17.1)	11 (31.4)
Not examined	10 (14.3)	4 (8.0)	10 (20.0)
Overall	20 (16.8)	11 (12.1)	21 (24.7)
Had problems performing normal household tasks because of OFP			
Examined	13 (26.5)	12 (29.3)	21 (60.0)
Not examined	17 (24.3)	9 (18.0)	23 (46.0)
Overall	30 (25.2)	21 (23.1)	44 (51.8)
Psychological distress (GHQ score 2–12, high)			
Examined	25 (53.2)	16 (43.2)	19 (54.3)
Not examined	35 (51.5)	21 (42.0)	23 (48.9)
Overall	60 (52.2)	37 (42.3)	42 (51.2)

4. Discussion

This population-based study has demonstrated, firstly, that it is possible to predict three broad types of OFP (musculoligamentous/soft tissue, dentoalveolar, neurological/vascular) using questionnaire information about OFP. This information consisted of the following six variables: OFP duration for more than 3 months; pain location (below orbitomeatal line); pain described as throbbing; pain described as miserable; pain occurring intermittently in a non-predictable pattern with pain-free intervals; pain arising from teeth. Secondly, it has enabled an estimation of the population prevalence of OFP according to the three broad types of pain.

There are several methodological issues relating to the study:

(1) The study achieved a high participation rate, and hence it is unlikely that non-participants influenced the results. In order to do so the non-participants with OFP would need to demonstrate different relationships between questionnaire data and clinical classification group. This seems very unlikely.
(2) Although the sensitivity and specificity of the statistical model used for prediction of classification for non-examined participants was high, the categories which have been used contain heterogeneous OFP conditions. For example, the final statistical model suggests that neurological/vascular conditions are less likely to be below then orbitomeatal line than musculoligamentous/soft tissue conditions. Whilst this is true for vascular conditions like headaches, conditions that are neuralgic (e.g. trigeminal neuralgia, glossopharyngeal neuralgia and superior laryngeal neuralgia) occur below the orbitomeatal line. These conditions which may therefore be wrongly classified by the final statistical model.
(3) The time difference between completion of the questionnaire and examination date was over a month for some participants. This however is likely to have made the prediction of OFP sub-type more difficult and to provide conservative estimates of model performance.
(4) The final multivariate model used for prediction included six factors. This, however, does not lessen the possible important role of other factors in the questionnaire. Such factors were either uncommon or were likely to be excluded during the modelling procedure because of high correlation with those factors remaining in the model. The multivariate models are derived from statistical decision rules with the inclusion/exclusion of factors offered to the model based solely on the factor's significance level within the model. The modelling procedure can be affected both by the group of factors offered and by subjects included in the model. Finally, the sensitivity and specificity of the instrument will be maximised in the group of subjects on whom the predictive model was developed.

It is difficult to directly compare the results to other estimated prevalence by OFP subtype to other population-based studies, as they have used different definitions of OFP and different diagnostic methods (Macfarlane et al., 2001). For example, OFP sometimes includes headache or toothache. Additionally, the time period to which the pain referred differs between studies and has ranged from current pain, pain in the past 4 weeks, pain in the past 6 months to pain in the past year. The prevalence reported here is given for the past month, but the different conditions display very different pain durations, and therefore measure of prevalence for other time intervals would modify the results. There was considerable variation among studies in the reported prevalence of OFP, ranging from 1 (current cheek pain) to 48% (current oral or facial pain) (Macfarlane et al., 2001). The 6-month period prevalence reported by Von Korff et al. (1988) in a large population study conducted in USA was 10% for severe headache and 12% for facial pain.

5. Conclusions

This study has derived a statistical model to classify participants with OFP in a population-based study into three broad groups (musculoligamentous/soft tissue, dentoalveolar and neurological/vascular) based on questionnaire information about OFP (OFP chronicity, location and verbal

descriptors of pain). It is potentially useful in large population studies of OFP, where a clinical examination is not possible, to determine prevalence, aetiological factors and identify the natural history of the disease. However, further validation of its performance in large populations are necessary.

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Appendix A. Algorithm for determining of OFP classification group

Classify as musculoligamentous/soft tissue, if $P_{\max} = P_1$
Classify as dentoalveolar, if $P_{\max} = P_2$
Classify as neurological/vascular, if $P_{\max} = P_3$

$$P_{\max} = \text{Maximum}(P_1, P_2, P_3)$$

$$P_1 = \Pr(\text{Muscololigamentous/soft tissue}) = \frac{1}{1 + e^{Z_2} + e^{Z_3}}$$

$$P_2 = \Pr(\text{Dentoalveolar}) = \frac{e^{Z_2}}{1 + e^{Z_2} + e^{Z_3}}$$

$$P_3 = \Pr(\text{Neurological/vascular}) = \frac{e^{Z_3}}{1 + e^{Z_2} + e^{Z_3}}$$

$$Z_2 = -0.103 - 1.432x_1 - 0.100x_2 + 1.321x_3 - 1.805x_4 - 0.295x_5 + 3.079x_6$$

$$Z_3 = 0.135 - 0.439x_1 - 1.955x_2 + 0.527x_3 + 0.016x_4 + 1.134x_5 - 0.167x_6$$

$x_1 = 1$ if OFP for more than 3 months, otherwise $x_1 = 0$
$x_2 = 1$ if OFP below orbitomeatal line, otherwise $x_2 = 0$
$x_3 = 1$ if throbbing pain, otherwise $x_3 = 0$
$x_4 = 1$ if miserable pain, otherwise $x_4 = 0$
$x_5 = 1$ if OFP occurs intermittently in a non-predictable pattern with pain-free intervals, otherwise $x_5 = 0$
$x_6 = 1$ if OFP arises from tooth/teeth, otherwise $x_6 = 0$

For example, if a participant indicated that OFP arises from tooth/teeth ($x_6 = 1$) and OFP was below orbitomeatal line ($x_2 = 1$), but other questions answered negatively, then $P_1 = 0.053$; $P_2 = 0.940$; $P_3 = 0.007$; $P_{\max} = 0.940$, therefore this participant should be classified in dentoalveolar group.

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