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ORIGINAL ARTICLE

P. Garhammer · G. Schmalz · K.-A. Hiller
T. Reitinger · W. Stolz

Patients with local adverse effects from dental alloys: frequency, complaints, symptoms, allergy

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Abstract Data on the prevalence of adverse effects from dental cast alloys and on the characteristics of the related patient groups are scarce. Therefore, the aim of the present study was to investigate patients in a defined part of Germany attributing oral complaints or symptoms to dental cast alloys. All dentists in the area of Eastern Bavaria (with 1 million inhabitants) were asked to send corresponding patients to our department during a 3-year period. Out of this collection, patients with complaints or symptoms in the oral cavity were recruited and characterized with regard to number, age and sex distribution, type of subjective complaints and objective intraoral symptoms, and allergy status based on an alloy analysis. Patients reporting to our department with suspected local adverse effects from dental cast alloys represented 0.01% of the population. Thirty-four percent of the patients were 50–59 years old, with females prevailing (76%). A great variety of subjective complaints was reported, which mainly resembles those reported by patients with adverse effects attributed to other dental materials like amalgam or denture base materials. The main objective intraoral symptoms were gingivitis, anomalies of the tongue (lingua plicata, lingua geographica), discoloration of the gingiva, redness of the palate or tongue and lichenoid reactions of the oral mucosa. In not more than 10% of the patients, allergy was diagnosed as contributing to the complaints or symptoms.

Keywords Dental alloys · Dental materials · Adverse effects · Allergy · Burning mouth

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P. Garhammer (✉) · G. Schmalz · K.-A. Hiller · T. Reitinger
Department of Operative Dentistry and Periodontology,
University Clinics of Regensburg, 93042 Regensburg, Germany
e-mail: gottfried.schmalz@klinik.uni-regensburg.de
Tel.: +49-941-9446024, Fax: +49-941-9446025

W. Stolz
Department of Dermatology, University Clinics of Regensburg,
93042 Regensburg, Germany

Introduction

More than 3,000 different dental alloys are available on the German market today [11], and a multitude of dental-restorative procedures are based on the use of these cast alloys. However, during recent years, case reports have been published indicating that oral tissue reactions may occur in contact with dental cast alloys [45, 53]. Oral complaints in association with dental materials – especially with dental alloys – have also been extensively and emotionally dealt with by the media in recent years [15].

Adverse clinical reactions associated with or allegedly attributed to dental cast alloys comprise different aspects. Many studies have been devoted to the prevalence of allergies in connection with metals or alloys in general, being verified by a skin test with the corresponding metal salts. However, these data cannot be simply transferred to dental alloys and their use in the oral cavity because of the special morphological and immunological properties of the oral mucosa [15, 37]. Reports of the prevalence of adverse clinical reactions to all dental materials used in daily dental practice based on literature surveys show that the frequency was estimated to be generally low. Kallus and Mjör [21] found 46 cases with (suspected) adverse effects out of 13,325 patients. According to Hensten-Pettersen [16], the incidence of adverse effects was estimated to be 1:400 in prosthodontic patients. In line with these reports, the rate of adverse effects toward amalgam is also assumed to be low: Herrström and Högstedt [17] reported on 218 patients recruited from Halland province with 254,725 inhabitants over a period of 2 years. Steinmann and Ott [44] found 202 cases during a 7-year period out of the North German region of about 41 million inhabitants. One must take into account that during these years, amalgam was by far the most frequently used dental filling material in posterior teeth [2], and the public was highly sensitive toward this topic.

From these reports, it can be assumed that the prevalence of adverse clinical reactions to dental cast

alloys is also low, but more specific data are not available. This may be due to several problems, one being the lack of knowledge about the composition of the inserted alloys [54]. Another problem is the large variety of different alloys, as has been mentioned above. Therefore, it is very difficult to verify that in a given case an adverse clinical reaction is caused by a special dental alloy. Furthermore, complaints by patients who attribute their symptoms to dental alloys are often general in nature and may be attributed to many other diseases or to medications [17]. Therefore, the aim of the present study was to investigate patients attributing oral symptoms to dental alloys in a defined geographical area (East Bavaria) with a population of about 1 million inhabitants. This patient collective group was characterized with regard to age and sex distribution, type of subjective complaints or objective symptoms, and allergy status based on an alloy analysis.

Materials and methods

Patient recruitment

In 1995, all dentists in the region of Eastern Bavaria, which has about 1 million inhabitants, were informed about the planned study in writing and were asked to refer patients with suspected adverse effects from dental alloys to the Department of Operative Dentistry and Periodontology of the University of Regensburg. Selection criteria were intraoral complaints or symptoms, like gingivitis, taste irritation, dry mouth or burning mouth in relation to metal restorations, except for amalgams. Patients with exclusively general symptoms were excluded. The survey was performed over a 3-year period.

Clinical examination

Standardized anamnesis questionnaires and clinical examination procedures were developed for the study. First, a general and detailed anamnesis was taken including information on type, location, time of appearance and duration of the symptoms. Then an extraoral and intraoral examination, including dental status, descriptive status of the oral mucosa, x-ray examination and periodontal status, were performed. The general oral hygiene was determined using the Papilla Bleeding Index (PBI) according to Saxer and Mühlemann [39]. Gingivitis adjacent to cast alloys, which were assumed to be responsible for the adverse reaction, was assessed using the Gingival Index (GI) according to Löe [26] and then compared with the corresponding value of a control tooth without restorations (in general, the collateral tooth either in the same jaw or – if not available – in the opposing jaw). To reduce the effects of bacteria as causes of gingivitis, a professional plaque removal was performed with oral hygiene instructions designed to motivate the patient. Rinsing with chlorhexidine (0.1%) for 1 week was prescribed. After mechanical and chemical plaque removal, the PBI and the GI were again recorded during a second appointment.

Allergy test

Allergy testing was carried out by means of patch testing on the patients' upper back skin and was performed in the Department of Dermatology of the University of Regensburg. The European standard series (Hermal, Hamburg, Germany) and the dental standard series (Hal Allergie, Düsseldorf and Hermal, Hamburg, Germany) were fixed with the Hayes Test Chamber N (Hal Allergie, Düsseldorf, Germany). Additionally, an (individual) allergy testing with small disks of all previously analyzed intraoral alloys of each patient was carried out. This analysis was performed on the basis of "biopsies" of all intraoral cast alloys, according to a modification of the method described by Wirz et al. [54], using the energy-dispersive x-ray analysis (EDX system AN 10/25, Link Analytical Ltd.; Stereoscan 240, Leica). From each of the alloys analyzed in a patient, round disks with a diameter of 5 mm and a thickness of 0.5 mm were cast according to the manufacturer's instructions. After removal from the muffle and sandblasting of the surfaces, the disks were finished with fresh abrasive paper in each case to a grit of 1,200. Alloys to which porcelain may be fused were additionally heat treated, according to the manufacturer's instructions and subsequently finished with an abrasive paper of a grit size of 1,200. If the manufacturer required special treatments of the alloy (e.g. etching), these measures were also carried out with the disk. Before applying the polished side of the disk on the back skin with a tape (Hal Allergie, Düsseldorf, Germany), the disks were disinfected with alcohol and again polished with 1,200 abrasive paper, to remove superficial layers of oxid. Again, for each alloy, a separate abrasive paper was used.

Forty-eight hours after applying the different materials on the back, they were removed, and the skin reactions were read and classified according to the recommendations of the "Deutsche Kontaktallergiegruppe DKG". On the third and seventh day after the beginning of the patch test, the skin on the upper back was evaluated again, according to the above mentioned criteria.

Statistics

Information on the anamnesis, subjective complaints, objective intraoral symptoms, and the results of the patch tests are descriptively presented. Data on the PBI and GI are given as medians with respective 25th and 75th percentiles. Discriminate statistics were performed with the Wilcoxon test. The significance level was set at α=0.05. For alloy analysis, three randomly selected particles of the alloy biopsy were analyzed, and for each metal component the arithmetic mean of the detected proportions was calculated. These proportions were subjected to a specially developed dBase IV (Ashton Tate, Chicago, Ill., USA) database system to select matching

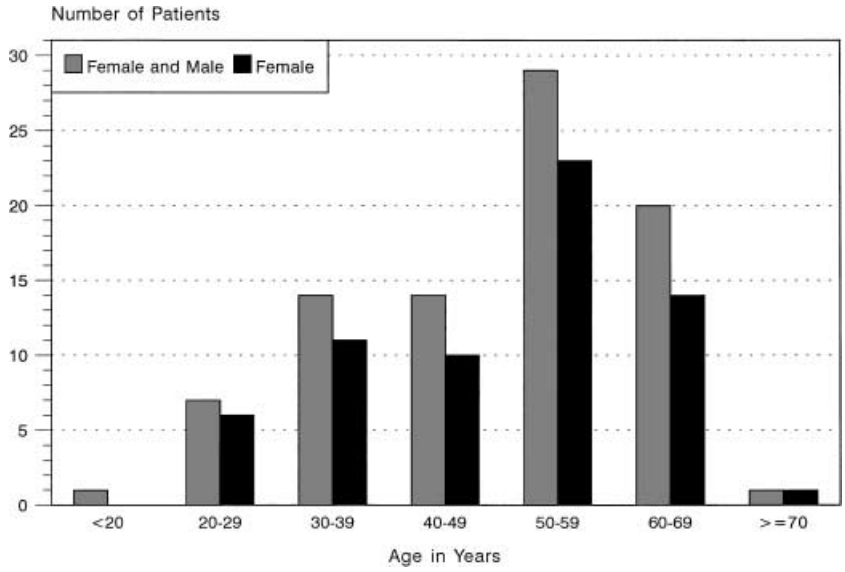

Fig. 1 Age and sex distribution of the patients (*n*=86)

commercially available alloys. This database contained all dental cast alloys available on the German market [9]. The composition of the alloys were given up to 0.1%.

Results

Number of patients, age and sex distribution

Two hundred fifty persons contacted the Department of Operative Dentistry and Periodontology by telephone during the period of 3 years. Out of these, 86 persons fulfilled the selection criteria and participated in the study. Out of 86 patients, 65 were female and 21 male. Elder patients (50–59 years) predominated. More females than males were seen in each age group (Fig. 1).

Subjective complaints

The main subjective symptoms are presented in Table 1. Multiple entries were possible, since most of the patients reported several complaints. A great variety of complaints were reported, including local symptoms in the oral cavity, as well as more general symptoms, e.g. weakness. Burning mouth (72%) and metal taste (56%) were mentioned most often. More than one third of the patients complained of an electrical sensation, dry mouth and taste irritation. More than 20 patients mentioned gingival bleeding, migraine or headache, gingivitis, blisters or weakness, followed by complaints such as paresthesia, toothache, red tongue, increased saliva flow, itching, red palate, intestinal problems, sensations of pressure, and articular pain.

Table 1 Main subjective complaints of the patients (*n*=86, multiple entries possible)

Main subjective complaints	Frequencies (%)
Burning mouth	72
Metal taste	56
Electrical sensation	44
Dry mouth	40
Taste irritation	37
Gingival bleeding	31
Headache	29
Gingivitis	28
Blisters	24
Weakness	24
Paresthesia	20
Toothache	20
Red tongue	16
Increased saliva flow	13
Itching	12
Red palate	9
Intestinal problems	9
Sensation of pressure	8
Articular pain	8

Table 2 Objective intraoral symptoms of the patients after plaque removal (*n*=86, multiple entries possible)

Objective intraoral symptoms	Frequencies (%)
No symptom	42
Gingivitis	23
Anomalies of the tongue	16
Discoloration	12
Red tongue	10
Red palate	8
Lichenoid lesions	6
Parodontitis apicalis	1

Objective intraoral symptoms

The frequency of the objective intraoral symptoms are summarized in Table 2. Again, multiple entries were possible. Forty-two percent of the patients showed no objective intraoral symptoms at all. Most patients with objective symptoms showed a gingivitis adjacent to crowns or telescopes (23%), which persisted after chemical and mechanical plaque removal (Fig. 2), followed by

Fig. 2 Patient (19-year-old male) with gingivitis adjacent to a high noble alloy

Fig. 3 Patient (32-year-old female) with redness of the palate adjacent to a chromium cobalt alloy

Fig. 4 Patient (57-year-old female) with lichenoid lesions adjacent to a high noble alloy

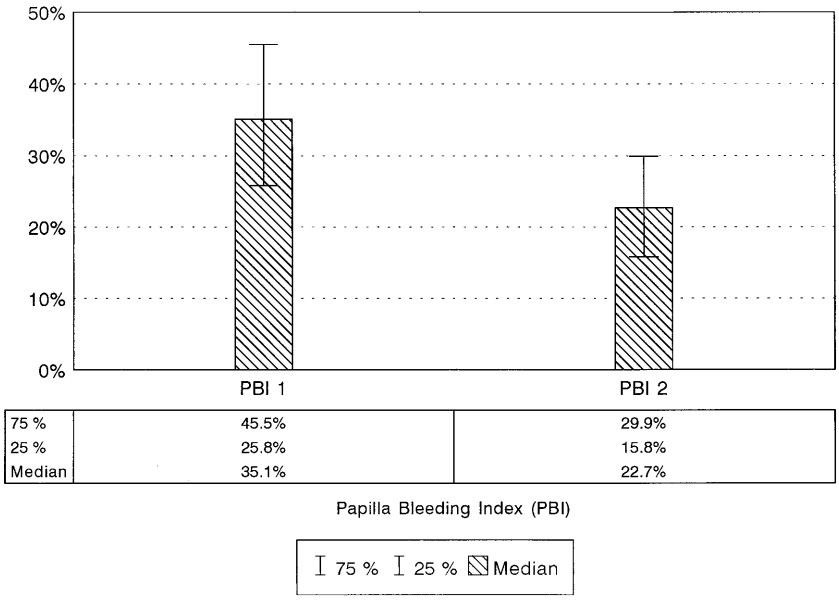

Fig. 5 Papilla Bleeding Index (PBI) before (PBI 1) and after (PBI 2) removal of the plaque

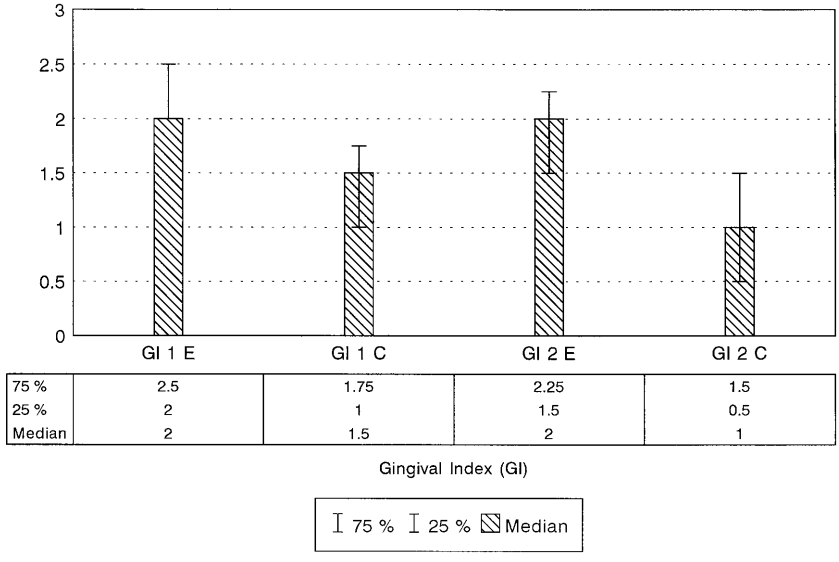

Fig. 6 Gingival Indices (GI) at the exposed site (E) and the control (C) before (GI 1) and after (GI 2) removal of the plaque

anomalies of the tongue (lingua plicata, lingua geographica), discoloration, red tongue and palate (Fig. 3), lichenoid lesions (Fig. 4) and one case of parodontitis apicalis.

Papilla Bleeding Index and Gingival Index

After mechanical and chemical plaque removal, the PBI (median) improved from 35.1 to 22.7% (Fig. 5), the difference being statistically significant (Wilcoxon test). With the help of these measures, the complaints of one patient (marginal gingivitis) could successfully be treated. Before plaque removal, the median of the Gingival Index of the exposed site was 2.0 and for the control 1.5. After plaque removal, the value of the exposed site was again 2.0 and for the control 1.0. The differences between the exposed site and the control site as well as between the situation before and after plaque removal were statistically significant (Wilcoxon test) (Fig. 6).

Allergy test

In the patch tests, altogether 17 patients showed positive reactions to metal salts (Table 3 and Table 4). Out of the 13 patients with reactions to nickel sulfate 5%, additionally, five patients showed reactions to palladium chloride 1%. Two patients were allergic to palladium chloride without additional nickel allergy. Reactions to the gold salt, gold sodium thiosulfate 0.5% (6% of the patients), cobalt chloride 1% (3% of the patients) and to the platinum salt ammonium tetrachloroplatinate 0.25% (1% of the patients) occurred more seldomly. None of the patients showed reactions to alloy disks. In most cases (except for nickel), the test substance was also a component of

Table 3 Positive skin reactions to metal salts in patch tests and their relevance (n=86, multiple entries possible)

Test substances	Positive skin reactions		Component of the intraoral alloy (number of patients)	Relevance (number of patients)
	(%)	(n)		
1. Nickel sulfate 5%	15	13	0	0
2. Palladium chloride 1%	8	7	7	3 (3) [a]
1. and 2.	6	5	5	3 (1) [a]
3. Gold sodium thiosulfate 0.5%	6	5	5	1 (4) [a]
4. Cobalt chloride 1%	3	3	2	1
5. Ammonium tetrachloroplatinate 0.25%	1	1	1	(1) [a]

[a] In parentheses questionable relevance

Table 4 Patients with positive skin reactions to metal salts in patch tests and their relevance

	Patient number																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Ni-salt	+	+	+	+	+	+	+	+	+		+	+				+	+
Pd-salt	+	+			+				+	+				+			+
Au-salt										+		+	+	+	+		
Co-salt		+							+								+
Pt-salt														+			
Alloy component	+	+			+				+	+		+	+	+	+		+
Relevance		+			+				?	?		+	?	?	?		+

the intraoral alloy (Table 3). For palladium chloride, we found three clinically relevant and three questionable cases (for definition of "relevance" see Discussion). For the gold salt and cobalt salt, we found one relevant case each. Four cases were questionable with the gold salt and one with the platinum salt. Regarding the patch test results per patient, a clinical relevance was found in four patients, and a questionable relevance was found in five cases (Table 4). The other cases were not relevant.

Discussion

Study design

The present study was designed as a diagnostic study of the open type, which means a trial in which subjects and investigators know which product each subject has received (opposite of double-blind study) [10]. We chose this design because a similar design was applied in studies on patients who allegedly suffered from adverse effects to amalgam [17, 44] and to removable dentures, bridges or crowns [27, 28, 55]. Furthermore, due to practical reasons, prospective studies are considered to be extremely difficult to perform because from the above-mentioned literature survey of adverse effects attributed to dental materials, an incidence of 1:1,000 seemed to be plausible. A total of 3,750 patients would have to be examined to statistically verify any reaction, which is out of the scope of this sort of study [49].

Only patients with complaints or symptoms in the oral cavity in relation to dental cast alloys were selected. Patients with exclusively general symptoms were not considered because experience with similar patients or groups who make other materials (e.g. amalgam) responsible for the general complaints suggests that with these patients mainly non-dental causes may be assumed [41, 44].

Number of patients

The 250 persons, who attributed symptoms to dental alloys, represent about 0.03% of the population of the region of Eastern Bavaria. If oral symptoms are used as selection criteria (86 persons), the percentage is 0.01%. Extensive epidemiological data on the frequency of adverse effects to dental materials in general and to metals or alloys in particular are not available. Some studies indicate a prevalence far below 0.1% [16, 21], which is in accordance with our findings. In literature surveys on adverse effects from dental materials, a generally low frequency of these effects was certified [30, 32]. Therefore, even if the present study design does not represent a classical epidemiological approach because some patient groups (e.g. those not trusting our institution) might have been missed, it can be concluded that the frequency of adverse effects from dental cast alloys is apparently low.

Age and sex distribution

Out of 86 examined patients, those between 50 and 59 years predominated, followed by the age group between 60 and 69 years. This is in accordance with results on adverse effects from removable dentures, bridges or crowns with an average patient age of 64 years [28]. In a clinical study of Yontchev et al. [55] with patients

experiencing orofacial and distant symptoms related to materials in fillings, crowns and dentures, patients between 50 and 59 years also predominated. Data of Reich and Hiller [36] show increasing tooth loss for the corresponding age groups. Therefore, it can be assumed that extensive restorations are carried out at this age, with a higher exposure rate compared to younger patients.

A similarly high portion of female patients was also observed in studies on patients with adverse effects associated with removable dentures, bridges or crowns [28, 55] and with amalgams [17, 44]. In patients with burning mouth syndrome females also prevailed; they were diagnosed with symptoms seven times more frequently than males [29]. The predominance of female patients in the middle and elder age groups might be related to changes in the hormonal balance. However, this hypothesis is not scientifically evident so far [15]. According to Tourne and Friction [46], oral discomfort after menopause was found to be independent of hormone levels measured. Neither systemic nor local application of estrogen has been shown to have a significant therapeutic effect on oral symptoms [46]. Also, in the present study, females predominated in the age group 20–29 years. This is – regardless of the hormonal changes at younger age (e.g. through contraceptive agents) – contradictory to the hypothesis of hormonal changes being a cause of the symptoms with female patients in the middle and elder age group.

General oral hygiene

General oral hygiene was improved significantly from 35.1% to 22.7% (PBI) after mechanical and chemical plaque removal. This treatment was performed to reduce the effect of plaque bacteria accumulating due to (insufficient) crown margins as a primary cause for gingival inflammation. In a study on oral hygiene in Germany, a mean PBI of 27.5% was measured with patients at the age of 35–54 years [35]. In the present study, the patients show similar oral hygiene behavior, suggesting that oral hygiene may not be a relevant cause for subjective complaints or objective intraoral symptoms. This is also in line with the fact that only one patient in the present study reported relief of symptoms after plaque removal. Van der Waal and Schulten [47] reported similar results with patients complaining of burning mouth.

Allergy

Allergic reactions to dental alloys are of the delayed type (type IV) and may be verified using the patch test [37]. The assessment of the response of patch tests is difficult even with proper administration. Thus, patch tests for confirming metal hypersensitivity are controversial [48]. However, this test was performed in this study because it is still considered to be the best approximation for diagnosis of metal hypersensitivity. According to Holmstrup [19], the basis for requiring allergologic examination of patients is the presence of whitish or reddish, sometimes ulcerative oral mucosa lesions with a clear anatomical relation to the restoration. However, other authors recommend carrying out patch tests even if visible oral lesions are not present, but only if the patients report subjective complaints [33]. In line with this recommendation in the present study, patients in a defined part of Germany attributing both oral complaints or oral symptoms to dental cast alloys have been patch tested to obtain information on the skin reactivity of this patient group.

On the top of the allergen list are metals such as nickel, palladium, gold, and cobalt [27, 38], which is reflected in our patch test results. Out of the 13 patients with nickel allergy, five (40%) also had a positive skin reaction to palladium, which is in line with the hypothesis of cross reactions between nickel and palladium described in the literature [1, 4, 48]. The high incidence of nickel allergy has been reported to be a result of the high frequency of exposure through jewelry [48]. Positive patch test results to gold salts have been reported and named gold allergy [7]. The clinical relevance, however, is not yet fully known [13].

In the present study in seven out of 17 patients with reactions to metal salts, the substance positive in a patch test was not a component of the alloy. Therefore, the positive patch test was not considered to be clinically relevant in these cases. Out of the remaining ten patients, a clinical relevance was assumed with four cases according to the recommendations of Purello et al. [33]: One patient showed objective intraoral symptoms and a time-related association between complaints and symptoms and the insertion of the dental restoration. The other three patients had local oral complaints adjacent to the alloy and, again, a time-related association between complaints and insertion of the alloy. With five patients (out of the above mentioned ten), the clinical relevance was considered to be uncertain because these patients could not confirm a time-related association between the occurrence of complaints or symptoms and the insertion of the restoration. The positive skin reaction (palladium chloride allergy) of one patient (out of the above mentioned ten) was not clinically relevant, although a palladium-containing alloy was analyzed because the patient was referred to us with grayish discolorations of the gingiva, so-called amalgam-tattoos. The palladium allergy was an incidental finding.

From these data, it can be concluded that, in not more than 10% of the patients, a metal causing a reaction in the patch test could be identified as contributing to the oral findings and the complaints of the patient, which is the classic diagnosis of metal-caused allergy. These results are confirmed by other authors, who found an allergy to dental materials to be rare [14, 15, 17, 51].

In the present study, alloy disks were cast and used for skin testing to perfom patch tests with the same material used for the intraoral restoration. None of the alloy disks tested, however, gave a positive patch test

even in patients in whom an allergy was diagnosed (see above). This is in agreement with the literature: In comparison to patch tests with alloy disks, more positive skin reactions could be observed using tests with the corresponding metal salts [4, 22, 37]. It may be due to the fact that metal ions are as such present in the solution, but with the cast alloy, corrosion must take place first. It may be assumed that the concentration of the ions is different [4, 22, 37]. The data of the present study do not support the general use of alloy disks for skin tests because they did not give further diagnostic information than tests with the corresponding metal salt, and in cases where we found clinical relevance of patch test results with salts, no such reaction was observed with the alloy disks.

Subjective complaints

Subjective oral complaints, like those reported in this study (e.g. burning mouth, metal taste), were described by Wirz et al. [52] on the basis of single cases and by Marcusson [27] and Kratzenstein et al. [24] in dental patient groups relating their various subjective problems to dental alloys. These symptoms were also observed in the tentative reports about adverse effects from alloys summarized by a patient organization [43] and in patients with suspected adverse effects to removable dentures, bridges or crowns [28]. Drugs may be a cause for complaints (e.g. taste irritation) similar to those allegedly attributed to dental alloys [42]. Furthermore, burning mouth sensations have been related to allergies [33, 47]. In a study by Kaaber et al. [20], 23% of the patients demonstrated an allergic reaction to substances in dentures, and the allergy was determined to be the cause of burning mouth. In the present study, however, out of 62 patients with burning mouth, in only 8% was a relevant allergy found.

The frequency and kind of different general complaints (e.g. headache, weakness) are similar to those reported by a patient organization [43]. However, these complaints can also be assigned to many other diseases (e.g. those of the blood system) [17]. In patients claiming side effects from dental alloys, prevailing symptoms were from muscles, joints and tiredness [27]. In an investigation by Schuurs et al. [41], patients with suspected adverse effects from amalgams reported similar general symptoms. The authors conclude that the mere fact of having amalgam fillings may be reason to attribute symptoms to them [41]. Therefore, the dentist should give expert advice to the patient to avoid unnecessary treatments.

Objective intraoral symptoms

Gingivitis adjacent to metal restorations was the most often found intraoral symptom in our patient collective. This is in line with reports of a patient organization [43]. Even after plaque removal, the degree of inflammation on the exposed site was still significantly higher than that at the control tooth. Therefore, although some plaque may still be present, an adverse effect related to the metal restoration may be assumed with these patients. Also Wirz [52] assumed an association between the dental alloys used for crown restorations and inflammation of the adjacent gingiva, which had not disappeared after periodontal treatment. However, in this study [52], information on the degree of inflammation, e.g. the Gingival Index, is not provided. In a clinical study, Kratzenstein et al. [25] found in three out of eight cases a gingivitis or hyperplasia adjacent to a dental alloy.

According to Wiltshire et al. [51], allergy may be a reason for gingivitis. However, in the present study, in only two out of 20 cases was an allergy toward a metal assumed to be the possible cause of the gingivitis. Toxicity of the released metal elements could be another reason for gingivitis adjacent to an alloy. Corrosion products, such as nickel or copper, are discussed in this context [45, 52]. Schmalz et al. [40] found in in vitro tests that heat treatment of the alloy, which is necessary for establishing a chemical bond between the ceramic and metal surface, results in enhanced solubility and release of non noble metals. In the present study, more than 60% of the alloys with an adjacent gingivitis were alloys to which ceramic had been fired.

Anomalies of the tongue (lingua plicata, lingua geographica) were found in 16% of our patients. No epidemiological data for the frequency of these anomalies in the German population in general could be found. A Swedish study showed that the frequency of tongue anomalies is only 7% [5]. Tongue anomalies may produce symptoms like burning tongue [47. 56]. In the present study, 10 out of 14 patients with tongue anomalies complained of a burning tongue. Zegarelli [56] reported of 57 patients with burning mouth with tongue anomalies attributed as playing an etiologic role in almost one third of the cases.

Grayish discoloration of the gingiva (12% of our patients) is described in the literature as non-irritating amalgam-tattoo [3, 19]. This is in line with our results: None of the patients with grayish discoloration reported subjective complaints. Amalgam particles may have been transplanted into the tissue during tooth preparation [3]. Rechmann [34] could also demonstrate components of the adjacent alloys (amalgam and silver-containing pins) in the neighboring grayish tissue using the laser-microprobe mass analysis.

A red palate adjacent to the alloy of a denture (base metal and high gold) was found in the present study in seven patients (8% of our patients). These patients complained of redness, inflammation, pain, etc. of the palate. These symptoms are summarized using the term denture stomatitis. It is mainly found under upper partial dentures [50]. Causes are denture trauma, poor oral/denture hygiene, 24-h denture wearers, fungal infection (candida species) and hypersensitivity to denture base materials [6, 18, 31, 50]. In the present study, there was no case with a relevant allergy. In addition, systemic

diseases and deficiencies of the immune system (e.g. diabetes mellitus) may be involved [12]. According to Taylor and Morton [45], pitting and crevice corrosion and the by-products of corrosion are implicated in this context as a potential cause of soft tissue reactions found beneath removable partial denture castings [45].

Whitish (lichenoid) lesions of the gingiva or mucosa were observed in five cases (6%) in our study. Lichenoid lesions can be regarded as a disease itself (lichen planus) and as a sequel of the restoration or both. According to Bolewska et al. [8], a material-related effect is assumed if the lesion is limited to the contact area with the material (contact lesion). Out of 25 patients with such lesions adjacent to amalgam, positive patch tests for mercury were found in 11 patients [8]. In the present study, two out of four patients with localized reactions had an allergy toward a component of the alloy. Koch and Bahmer [23] reported that ten patients had lichenoid lesions in contact with amalgams and a gold crown. In five of these cases, combined sensitization to mercury and other metal salts was observed.

Conclusion

It can be concluded that within the limitation of the study design, the number of patients reporting adverse effects from dental cast alloys is generally low. The majority of the patients are middle- or old-aged, predominately female, being seriously impaired in most cases. The great variety of subjective complaints is similar to those reported by patients with suspected adverse effects of other dental materials (e.g. amalgam, acrylic resin). Allergy is a recognized but rare cause for adverse effects. The information of the composition of the alloy is needed as a basis for the skin test. If the composition of the incorporated alloys is unknown, collaboration with a center performing EDX analysis is recommended. The present data, however, do not provide evidence for the use of alloy disks for skin tests.

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