IN BRIEF

- Oral lichenoid lesions (OLLs) may be elicited by dental restorations and amalgam restorations with their mercury content appear to be a major aetiological factor.
- The diagnosis depends mainly on the clinical findings including the lesions' characteristics and relationship to restorations. Patch testing seems to be of limited value.
- Replacement of dental restorations can result in the resolution or improvement of OLLs in most instances.

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CPD PAPER

Oral lichenoid lesions related to dental restorative materials

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Objectives To determine the effectiveness of replacing restorations considered to be the cause of an oral lichenoid lesion (oral lichenoid reaction)(OLL).

Design Clinical intervention and nine-month follow up.

Setting The study was carried out in the University Dental Hospital of Manchester, 1998–2002.

Subjects and methods A total of 51 patients, mean age 53 (SD 13) years, who had oral lesions or symptoms suspected to be related to their dental restorations were investigated. Baseline patch tests for a series of dental materials, biopsies and photographs were undertaken. Thirty-nine out of 51 (76%) of patients had their restorations replaced.

Results The clinical manifestations of OLL were variable; the majority of OLL were found to be in the molar and retro molar area of the buccal mucosa and the tongue. Twenty-seven (53%) patients had positive patch test reactions to at least one material, 24 of them for one or more mercury compound. After a mean follow up period of nine months, lesions adjacent to replaced restorations completely healed in 16 (42%) patients (10 positive and 6 negative patch tests). Improvement in signs and symptoms were found in 18 (47%) patients (11 positive and 7 negative patch tests).

Conclusion OLLs may be elicited by some dental restorations. Replacing restorations adjacent to these lesions is associated with healing in the majority of cases particularly when lesions are in close contact with restorations. A patch test seems to be of limited benefit as a predictor of such reactions.

INTRODUCTION

Biocompatibility is defined as 'the ability to perform with an appropriate host response in a specific situation'. The most appropriate response in some situations is no response.¹ In other words the material should be non-toxic, non-allergic, non-irritant, non-carcinogenic, and non-thrombogenic.

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Refereed paper

Received 28.07.03; Accepted 19.01.04

doi: 10.1038/sj.bdj.4812176

© British Dental Journal 2005; 198: 361–366

Oral lesions related to dental restorative materials are not uncommon in dental practice. The literature includes many reports on the possible association between allergic reactions and dental restorative materials.^{2–7} The majority of these deal with the association between metallic dental appliances and allergic reactions of the oral mucosa. The most commonly reported problems of local exposure to restorative materials are local inflammatory reactions due to their toxic, irritant, or allergic effects.

Biodegradation of dental materials is of fundamental importance to their biocompatibility because the release of elements from them is nearly always necessary for an adverse reaction to arise. Biological response to released elements depends on what is released, the quantity released, the duration of exposure to the susceptible tissue and other factors.⁸ The complex environment at the surface of restorations is comprised mainly of saliva whose composition varies over time in each individual. The corrosion resistance of alloys in this environment results, in part, from the formation of a protective oxide film. Under certain conditions the stability of this protected film can be damaged and constituent elements in the alloy are released.⁹

With amalgam alloys mercury may be released as a result of dissolution, evaporation, corrosion, or other form of degradation. Released mercury is reported as being taken up by oral soft tissues^{10,11} and in some patients this appears to result in local toxic or allergic effects that present as oral lichenoid lesions (oral lichenoid reactions) OLLs.^{6,7,10–13} Clearing of the lesions after removal of amalgam restorations in such patients has been

Table 1 List of systemic diseases of patients with OLLs included in this study and the control group of patients with OLP

Systemic diseases	OLL patients n (%)	OLP patients n (%)	χ^2 test P values
One or more diseases	28 (54.9)	36 (70.0)	0.101
Cardiovascular diseases	8 (15.7)	12 (23.5)	0.318
Musculoskeletal and joints disorders	9 (17.6)	11 (21.6)	0.618
Respiratory diseases	5 (9.8)	4 (7.8)	0.727
Diabetes	2 (3.9)	0 (0)	0.153
Central nervous system	2 (3.9)	4 (7.8)	0.400
Obstetrics, gynaecology, and urinary tract disorders	2 (3.9)	6 (11.7)	0.141
Gastrointestinal system	2 (3.9)	4 (7.8)	0.400
Other diseases	6 (11.8)	6 (11.8)	1.00
Any allergy	22 (43.1)	20 (39.2)	0.687

Fig. 1 An oral lichenoid lesion adjacent to amalgam in a 38-year-old female (A). Patient had positive patch test for ammoniated mercury. After removing amalgam restorations, dramatic relief of symptoms was found within two weeks. Complete healing was found after 3 months (B)

reported previously by several authors.^{14–16} The substitution of amalgam by another material in these studies was based upon a positive patch test to mercury^{17,18} and/or the anatomical relationship with the amalgam restoration.^{19,20} However, the clinical value of epicutaneous patch tests to materials used in dentistry is unclear¹⁸ and regression of oral mucosa lesions after removal of amalgam has been found regardless of the results of the patch test.²¹

This study attempted to define the clinical features of oral lichenoid reaction lesions caused by dental restorative materials and to evaluate the effectiveness of replacing restorations adjacent to oral lichenoid lesions. Whilst several other studies have been undertaken in this area most have lacked careful control, varied in their detail, and related to Scandinavian countries.²² It appears from the increasing number of publications on this subject that contact OLLs are becoming an increasing problem.

The aims of the study were:

- To evaluate the clinical and pathological features of OLLs considered to be related to amalgam or other alloys.
- To compare the characteristics of OLLs with a control group of patients with oral lichen planus OLP.
- To evaluate the healing of OLLs after replacing restorations, in respect of prior patch tests and the anatomical relationships between suspect restorations and the lesions.

SUBJECTS AND METHOD

Subjects

The sample was derived from patients referred to the Oral Medicine Unit, University Dental Hospital of Manchester during 1998–2002. Inclusion criteria required a clinical diagnosis of OLLs topographically related to restorations of various dental materials and alloys, with or without histological and patch test confirmation. Oral lichenoid lesions included striated, reticular, plaque-like, erythematous, erosive, vesiculated, and ulcerative forms. Patients' complaints were of soreness, itching, an unpleasant metallic or battery taste, and pain.

Baseline investigations

History and clinical records.

1. Comprehensive history of the complaint and the medical, dental and social histories.
2. Patients' detailed description of oral symptoms and complaints, onset in relation to dental treatment, impact of symptoms on discomfort, what they were doing to limit their discomfort.
3. Record of the lesions
 - a) Classified clinically into three groups:
 - White patches, striated, plaque, or reticular lesions
 - Erosive or atrophic lesions
 - Ulcerative lesions
 - b) Classified according to their relationship with restorations:^{10,19}
 - Oral lichenoid lesions only in contact with restorations
 - Oral lichenoid lesions in clinical contact, and at least one additional site without clinical contact with restorations

Table 2 History of OLL patients' allergy towards variety of materials

Agent to which patients were allergic	n (%)
Antibiotics	9 (17.6)
Metals or false jewellery	8 (15.6)
Drugs	5 (9.8)
Pets	1 (2)
Hay fever	1 (2)

Oral lichenoid lesions without clinical contact with restorations
c) Classified according to their oral location:

Oral lichenoid lesions located on the buccal mucosa (unilateral or bilateral)

Oral lichenoid lesions located on the tongue (lateral surfaces or dorsal surface).

Gingival lichenoid lesions.

Other part of oral mucosa; lips, floor of the mouth, and palate.

Special tests

1. Microbiological and haematological investigations:

- Swabs and smears to detect *candida*
- Full blood, blood film, serum ferritin, serum vitamin B, iron, total iron binding capacity, rheumatoid factor and antinuclear factor.

2. Biopsy.

3. Patch test: European standard series and series of dental materials were applied on the forearm or back for 48 hours. Results were read 30 minutes after removing from the forearm. Patients were requested to contact the Oral Medicine Unit if further reactions occurred. The results of patch tests were marked as (-) negative, (?) doubtful, (+) weak reaction (non-vesicular), (++) strong reaction (edematous or vesicular), or (+++) extreme reaction (bullae or ulceration) and considered positive when recorded as (+), (++) or (+++) reactions.

Replacement of restorations

Local medication (most commonly topical corticosteroids such as Adcortyl in Orabase) was offered to patients with subjective symptoms prior to restoration replacement. Replacement of restorations was carried out for 39/51 (76%) patients, four patients did not require treatment (lesions resolved spontaneously), four decided not to have their restorations replaced at the time of the study and four were lost to follow up. Thirty-four out of 39 (87%) patients had amalgam restorations replaced, four had a fixed prosthesis and one patient a removable denture. The same operator (YI) provided all the treatment. A total of 146 new restorations were placed, 108 resin composites, 22 gold crowns, and 16 ceramics. In addition, two acrylic partial dentures were provided and two teeth were extracted. Patients were followed up for a mean period of nine months (range 4–32 months). Follow-up examination included evaluation and a clinical photographic record at 1, 3, and 6 months and when available at 12 and 24 months.

Table 3 OLL patients: patch test results.

Dental series	Number (%) with positive results	Total number of tested patients	Detail of test result
Ammoniated mercury 1%	21 (43.8)	48	(?) 2 (+) 12 (++) 9
Amalgam	14 (30.4)	46	(?) 2 (+) 10 (++) 4
Amalgam alloying metals	2 (5.0)	40	(?) 1 (+) 1 (++) 1
Potassium dichromate 0.5%	2 (9.5)	21	(+) 1 (++) 1
Cobalt chloride 1%	3 (9.7)	31	(?) 4 (+) 1 (++) 2
Nickel sulphate 5%	5 (14.3)	35	(++) 2 (+++) 3
Palladium	3 (11.1)	27	(?) 3 (+) 1 (++) 2

Patch tests were applied on the forearm or back for 48 hours and results were read after 30 minutes. The results of patch tests were marked as (-) negative, (?) doubtful, (+) weak reaction, (++) strong reaction, or (+++) extreme reaction and considered positive when recorded as (+), (++) or (+++) reactions

Fig. 2 Oral lichenoid lesion adjacent to amalgam in a 56-year-old-female (A). Patient had negative patch test for mercury compounds. Symptoms became worse in the next few days after removing amalgam (B). After replacing amalgam with glass ionomer core and gold crown complete healing was found after 3 months (C).

Clinical results were graded as:

- Complete healing (absence of clinical signs and symptoms)
- Marked healing (ie changes in size and/or into a less severe clinical form of the lesion)
- No improvement or worse.

Comparative sample

This sample was taken from patients with OLP who registered with the Oral Medicine Unit between 1995–1999 for comparison with medical aspects and the type and distribution of lesions. For each patient with OLL a matched patient with OLP with the same gender and age within 5 years was included. The investigation included medical history and medications, tests for *candida* and haematological investigations. OLP lesions characteristics were classified as shown above for OLLs.

ETHICAL CONSIDERATIONS

The work was undertaken as part of additional routine care offered to patients for a period of time, and with the approval of their general dental practitioners. It was designed to provide for better guidance for the best approach to deciding on giving advice to patients with OLLs and the role of patch tests as a predictor. Patients with OLP were not patch tested since tests in this group are reported to be of no benefit as a predictor of a local cause.

STATISTICAL METHODS

Statistical analysis involved descriptive statistics, χ^2 , Fisher exact and Mann-Whitney *U* test, where appropriate.

RESULTS

Subjects

Age and gender

The number of patients with oral lichenoid lesions included in this study was 51, six of whom (12%) were male and 45 (88%) were female. The mean age was 53 years (SD 13).

Medical status (test group OLL and control OLP)

There was no statistical difference in the medical status between the two groups of patients (Table 1) (χ^2 test $p = 0.101$). For example, 28 (55%) patients with OLL and 36 (70%) of patients with OLP reported one or more general diseases (such as cardiovascular diseases, joint disorders, respiratory diseases, or diabetes); most of these were under control or treatment. A history of allergy to metals, chemicals, medication, or other were recorded in 22 (43%) patients with OLL and 20 patients with OLP (39%), with no significant difference between the two groups (χ^2 test, $p = 0.687$).

Table 4 Types of lesions in patients with oral lichenoid reactions/lesions and patients with OLP.

Type of lesion	OLL patients n (%)	OLP patients n (%)	χ^2 test
White patches, plaque, or reticular	33 (67)	35 (67)	0.891
Erosive or atrophic	24 (49)	21 (41)	0.433
Ulcerative	6 (12)	2 (4)	0.125
Total	49 (100) #	51 (100)	

p values#2 patients did not have lesions (only symptoms).

(Table 1). History of allergy to metals or false jewellery was found only in 8 (15%) patients with OLLs (Table 2). In the test group, 7 (14%) patients showed an abnormality in at least one blood test, these values were later corrected and 8 (16%) patients had a positive swab and/or smear for *candida*. The majority of OLLs patients claimed a low intake of alcohol; four were smokers and seven used to smoke.

Patch tests (test group)

Patch tests were positive in 27 (53%) patients; 24 (47%) of them for at least one mercury compound (Table 3). Out of 35 patients patch tested with 5% nickel sulphate, 5 (14%) patients showed strong positive reactions. Similar patch test results were found for chromium, palladium and cobalt (10% positive) (Table 3). All patients showed negative patch tests for materials included in resin and methacrylate dental materials such as Methyl methacrylate 2%, Bisphenol A 1%, Ethyleneglycol Dimethacrylate (EGDMA) 2%, Triethyleneglycol Dimethacrylate (TEGDMA) 2%, Bisphenol A Dimethacrylate 2%.

Lesions (test and control groups)

The clinical features of OLLs were variable and included white or red patches, reticular, erosive, or ulcerative forms (Table 4). Symptoms accompanied with lesions were reported in 42 (82%) patients. Sore mouth or tongue were most frequently reported in 28 (55%) patients. Fifteen (29%) patients described their symptoms as painful, 4 (8%) as tenderness, two patients had a metallic or bad taste, and 13 (25%) patients reported difficulty when eating. Aggravation of symptoms by spicy food or orange juice was frequently reported. In 34 patients, lesions were suspected to be related to their amalgam restorations. The majority of these lesions were located in the molar and retro molar areas of the buccal mucosa and lateral border of the tongue (Table 5). Lesions were in complete or partial contact with restorations (Table 6). In four patients, complaints were suspected as related to their prosthesis. Three of them had erythema on the palate or buccal mucosa, one complained of objective symptoms only. The onset of the symptoms in these four patients was related in time to when their restorations were placed. In one patient there was no

Table 5 Distribution of lesions, in patients with oral lichenoid reactions/lesions and patients with OLP.

Distribution of lesions	OLL patients	OLP patients n (%)	χ^2 test or Fisher exact test p values
Buccal mucosa	39 (79.6)	47 (92.2)	0.07
Bilateral	25 (51.0)	18 (35.3)	
Unilateral	14 (28.6)	29 (56.9)	
Tongue	33 (67.3)	25 (49.0)	0.063
Bilateral border	19 (38.8)	10 (19.6)	
Unilateral border	14 (28.6)	9 (17.6)	
Dorsum	2 (4.1)	6 (11.8)	
Ventral	1 (2.0)	0 (0)	
Gingiva	2 (4)	18 (35.3)	<0.001
Palate	2 (4)	3 (5.9)	1.00
Lips	0 (0)	6 (13.7)	0.013
Floor of the mouth	0 (0)	2 (3.9)	0.161
Total	49 (100) #	51 (100)	

#2 patients did not have lesions (only symptoms)

Fig. 3 Female aged 43 years with soreness and erythema of the palate following placement of a bridge on anterior teeth (A), and a history of metal allergy and positive patch test (palladium and nickel) (B). Replacement of bridge with full ceramic bridge (Procera) resolved the problem (C).

complaint but the patient was referred to restore a missing lateral incisor since the patient had a history of metal allergy and showed strong patch test reactions towards several metals. The histological features of the biopsies were of lichen planus, with the possibility of lichenoid reactions reported in 25 (49%) patients.

There was no significant difference in the type of lesion between OLL and OLP lesions (Table 4). There was no significant difference between OLL and OLP lesions affecting the buccal mucosa and the tongue (χ^2 test $p = 0.07$ and $p = 0.063$). However the gingiva were found to be more affected in OLP 18 (35%) patients than OLL 2 (4%) (χ^2 test $P < 0.001$). OLL lesions were found in close or partial contact with restorations more frequently than OLP lesions. There was a statistically significant difference between the two groups of lesions regarding their relationships with restorations (χ^2 test $P < 0.01$) (Table 6).

Healing of OLLs

Lesions healed or improved markedly, and symptoms resolved, in the majority of patients after replacement of their restorations (Table 7) (Figures 1–3). Complete healing was found in 16 (42%) patients, improvement in 18 (47%) patients and no improvement in 4 (11%) patients. Dramatic relief of symptoms and improvement of lesions were found after one week in some patients, but a minimum of three months was usually required. Healing of lesions on the lateral border of the tongue was faster than other sites. Lesions on the gingivae did not respond to the treatment. Four patients showed either complete healing (1 patient) or marked improvement (3 patients) without the need to replace their restorations. In some patients the symptoms became worse in the next few days after removing their amalgam restorations, particularly when no rubber dam was used.

Healing and patch test results

There was no difference in healing between patients with positive and negative patch tests (Mann-Whitney U test $p = 0.378$). Patients with either positive or negative patch test results showed improvements after replacing their restorations. In 21 out of 22 (95%) patients with positive patch testing and 13 out of 16 (81%) patients with negative results complete healing or a marked improvement was seen (Table 7).

Healing and topographical relationships between lesions and restorations

Lesions in complete or partial contact with restorations improved after replacing related amalgam restorations. Complete healing was obtained when lesions were in close contact with restorations in 10 out of 16 (63%) patients whereas in partial contact cases in 6 out of 22 (27%) patients, lesions healed completely. There was a statistically significant difference in the healing of lesions regarding their topographical relationships with restorations (Mann-Whitney U test $p = 0.04$) (Table 7).

DISCUSSION

This study aimed to clarify the clinical features of the oral lichenoid reactions/lesions induced by dental restorative materials, to evaluate the different diagnostic methods for relating lesions to restorations, and to evaluate the benefits of replacing

these restorations. Fifty-one patients were included in the study. The morphological features included white or red patches, erythema, erosions and ulcerations. Pain or soreness of mouth and tongue accompanied most cases. The majority of the lesions were located in the molar and retro molar areas of the buccal mucosa and lateral border of the tongue. Lesions were in complete or partial contact with restorations. The histopathological features were difficult to distinguish from those of oral lichen planus. The prevalence of OLLs among women was some seven times higher compared with men, and was highest in those between 45 and 65 years of age.

Several studies, mainly Scandinavian, have shown the benefit of replacing restorations on the healing of lichenoid reactions. Complete healing of lichenoid lesions after the replacement of dental amalgam in 28/62 (42%) patients with positive patch tests results and 3/15 (20%) with negative patch test results was reported by Laine *et al.*¹⁴ Bolewska *et al.*¹⁰ reported on the replacement of amalgam restorations with resin composite, porcelain fused to gold crowns, or the prevention of contact between amalgam restorations and the oral mucosa by an acrylic splint. They found that in 24/25 patients with lesions restricted to the contact zone with the amalgam restorations and 1/11 patients with lesions both in the contact zone with amalgam restorations and in areas exceeding the contact zone, there was either a total or marked improvement. Oral lesions have also been reported to be related to base metal alloys^{2,5,23,34} and to have healed or improved after replacing the prostheses containing them.

In the current study, replacement of restorations was offered to patients and 39 of 51 patients had their restorations replaced at the University Dental Hospital of Manchester. The majority of patients who had their restorations replaced became free from their subjective symptoms. The results of this study are in agreement in general with other studies.^{15,21,25} Spontaneous remission of lesions was also observed in four patients. Two patients with longstanding lesions (over ten years) had complete healing after replacing their restorations.

Patch testing when used properly often provides support for the diagnosis of allergic contact dermatitis.²⁶ Allergic contact stomatitis is said to be usually associated with actual or potential allergic hypersensitivity of the skin.²⁷ Fisher²⁷ argued, 'a positive patch test reaction may have relevance to the present or past or may be unexplained'. Another limiting factor of patch testing is false positive or negative results arising from the test methodology or concentration of the test compound. A positive test result to one compound of mercury does not imply a response to all compounds, or mercury itself. Nevertheless a patch test is considered to show whether there is a risk that contact allergy reactions may occur if certain materials are used in a particular patient. The frequency of positive patch

Table 6 Relationships to restorations of lesions in patients with oral lichenoid reactions/lesions and patients with OLP.

Relation to restorations	OLL patients n (%)	OLP patients n (%)
Close contact	21 (43)	2 (4)
Exceeding contact	28 (57)	17 (33)
No contact	0 (0)	32 (63)
Total number of patients	49 (100) [#]	51 (100)

[#]2 patients did not have lesions (only symptoms)

Table 7 Healing of oral lichenoid reactions/lesions after replacing restorations and healing of lesions related to patch test results and topographical relationships between lesions and restorations

OLL patients	Complete healing n/N (%)	Marked improvement n/N (%)	No improvement n/N (%)
Patch test			
Positive	10/22 (45.5)	11/22 (50.0)	1/22 (4.5)
Negative	6/16 (37)	7/16 (44)	3/16 (19)
Topographical relationship between lesions and restorations			
Close contact	10 (62.3)	5 (31.3)	1 (6.3)
Exceeding contact	6 (27.3)	13 (59.1)	3 (13.6)
Total patients with OLL	16/38 (42.1)	18/38 (47.4)	4/38 (10.5)

#2 patients did not have lesions (only symptoms)

tests to mercury compounds in patients with OLLs has been reported to be between 16%–68%^{10,14,28} and 47% in the present study. Thornhill *et al.*²⁹ showed that in 51 patients with OLP and at least one amalgam restoration in each patient that two patients (3.9%) had positive results towards mercury or amalgam. This indicates that patch testing is an unnecessary procedure in patients with OLP or when no or weak clinical relationships between amalgam and lesions and should be avoided.

In the present study OLLs resolved or markedly improved in 13/16 (81%) patients with negative patch tests. There was no statistically significant difference in healing between patients with positive and negative patch testing results. This lack of difference strongly questions the benefit of using cutaneous patch testing for OLLs. These findings support those previously reported investigations.^{18,30} In a recent study Thornhill *et al.*²⁹ concluded ‘strong associations between lesions and amalgam restorations plus a positive patch test result was a good predictor of lesion improvement on amalgam replacement’. Despite this the study showed that among 28 patients with strong relationships between lesions and amalgam, 7/8 (87.5%) patients with a negative patch test and 19/20 (95 %) with positive patch test were completely or substantially improved after amalgam replacement. Their results, contrary to their conclusion, support our finding that a patch test is a limited predictor for amalgam replacement.

There was a statistically significant difference in the healing of lesions according to their topographical relationships with restorations. This indicates that the topographical relationship between lesions and restorations is a more useful prognostic indicator but is not conclusive. Parafunctional habits may also exacerbate lesions close to restorations and occasionally lead to misclassification. The topographical relationships between lesions and restorations were the main difference between oral lichenoid lesions (test subjects) and oral lichen planus (control subjects), whereas the medical status and type of lesions were similar.

Lichen planus LP is a cutaneous disease with and without oral manifestations. Oral lichen planus OLP has various clinical manifestations including reticular, plaque, papular, atrophic, erosive and bullous forms.^{31,32} The reported prevalence ranges from 0.5 – 2.2%.^{31–34} More than one clinical form is frequently present at a time. Patients are usually between 30 to 60 years and 60% of patients with OLP are women. Lichen planus is thought to reflect a cell-mediated reaction, with T lymphocytes as the main effector cells.³⁵ A few cases of OLP have been associated with diabetes mellitus³⁶ and candidiasis.³⁷ Under the microscope the affected area shows characteristic change: a band-like, mainly lymphocytic, immuno-inflammatory infiltration next to the basement membrane. There is liquefaction degeneration of the basement membrane and destruction of basal cells. Diagnosis is straightforward, by history, clinical examination and confirmatory biopsy. Current treatment may reduce the pain and severity of lesions but is not curative.^{38,39} The clinical manifestations and histopathological

changes of lichenoid lesions and those for oral lichen planus are similar. Therefore it is important to distinguish between the two groups of lesions since their aetiology and hence their treatment is different.

Side effects from a dental restorative material can be either toxic/irritative or allergic in nature. Therefore the aetiology of OLLs may represent the oral manifestation of a chronic irritation in some patients or be the clinical result of a delayed hypersensitivity reaction in others. Allergic contact lesions represent a lymphocyte-mediated delayed type of hypersensitivity reaction that requires previous sensitisation to the same chemical. In a study Massone *et al.*⁴⁰ found that nickel, cobalt, and potassium dichromate were the three most common sensitisers; concomitant positive reactions were present at significant levels. Whereas irritant contact lesions are a form of local inflammation induced by primary contact with chemicals and are not mediated by lymphocytes. A chronic toxic reaction may be established due to repeated or constant influence of toxic agents in low concentrations over long periods of time. Such reactions are most frequently localised to the contact zone with the toxic agent. Chronic toxic reactions may be seen in areas of the oral mucosa in direct contact with restorations. Very little is known about toxic reactions of the oral mucosa due to amalgam. A pronounced cytotoxic effect of dental materials on cell cultures of oral cells has been reported.^{41,42}

Another cause of lesions related to dental restorations may be immunological or toxic reactions to plaque accumulations on the surfaces of the restorations. Such lesions may disappear after improved oral hygiene.⁴³ Plaque reduction may also have surprising effects on mucosal lesions of lichen planus.⁴⁴ Also psychological aspects and the life style of patients with oral lichenoid reactions should be considered. The results of two published investigations^{25,45} showed that patients with oral lichenoid reaction have a tendency to be depressive compared with a control group. The marital status (patients who were divorced or their partner had died) and the frequency of physical activity are also reported to be significantly higher in patients with oral lichenoid reactions than those in control groups.

CONCLUSIONS

With the limitation of the study the following conclusions can be made:

- OLL may be elicited by dental restorations and the diagnosis depends mainly on the clinical findings including the lesion's characteristics and relationship to restorations. Amalgam restorations with their mercury content appear to be a major aetiological factor.
- A rubber dam should be applied and good suction and cooling should be used to remove the traces of removed amalgam. This avoids ingestion, minimises inhalation of mercury vapour and largely eliminates the risk of an exacerbation of the lesion during amalgam removal.
- Replacement of dental restorations can result in the resolution or improvement of OLL in most instances with relief from symptoms in most cases after a short period although a improvement in lesions needs a minimum of 3 months.
- Patch testing seems to be of limited value. The topographical relationship between the OLL and the restoration appears to be a useful prognostic marker but is not conclusive.
- Further *in vivo* and *in vitro* studies are required to achieve a better understanding of the aetiology of OLLs and to provide conclusive diagnostic indicators.

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