# Frictional Keratoses on the Facial Attached Gingiva Are Rare Clinical Findings and Do Not Belong to the Category of Leukoplakia

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**Purpose:** To investigate the clinical and histologic features of frictional keratoses located exclusively on the facial attached gingiva and establish whether these belong to the category of leukoplakia.

**Materials and Methods:** Over a period of 15 years, 159 patients presenting with oral keratotic plaques, located exclusively on the facial attached gingival mucosa, excluding the edentulous alveolar ridge and retromolar pad area, were retrospectively selected. Clinical and histologic features and the symptoms and progression of these lesions were carefully assessed.

**Results:** The presence of oral frictional keratosis located exclusively on the facial attached gingival mucosa was clinically and immunohistologically diagnosed in 14 of 159 patients (8.8%). Eleven patients (78.5%) showed unilateral involvement, whereas 3 patients (21.5%) had bilateral involvement. The disappearance of the lesions was accomplished in only 9 of 14 patients, resulting from discontinuation of bad habits. Clinically, these lesions appeared as distinct, sharply demarcated, isolated, asymptomatic, homogeneous whitish-plaques that were neither removable nor painful. The plaques did not create discomfort, change shape, or develop into malignancy. Histologically, these plaques showed features superimposable to those present in benign alveolar ridge keratoses.

**Conclusion:** The results highlighted that frictional keratoses on the facial attached gingival mucosa *1*) are rare findings, *2*) clinically appear as "true leukoplakia" but histologically have the same features as benign alveolar ridge keratoses, *3*) have no propensity for malignant transformation, *4*) have a good prognosis, and *5*) have a specific cause, and resolution is accomplished if the frictional element is eliminated. Thus, these must be removed from the category of leukoplakia.

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Oral frictional keratosis (OFK) is a benign, self-limiting oral condition caused by the constant rubbing of 2 surfaces against each another, whereby the production of keratin filaments produces a characteristic clinical

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aspect of white patches.[1] OFKs represent a chronic, mechanical process, which tends, in most cases, to reduce or disappear within 1 to 3 weeks if the causative agent is carefully removed. Thus, this condition is more frequent in patients with particular habits and is generally found by chance during routine oral examination.

OFK is an especially evident alteration in areas of mechanical trauma and may be due to different conditions: *1*) excessive force while brushing the teeth with an overly stiff brush (toothbrush keratosis); *2*) constantly rubbing the tongue against the teeth (tongue thrust keratosis)[2,3]; *3*) constantly pushing the cheeks between the teeth while gently sucking or biting on the buccal tissues along the plane of occlusion (linea alba), often bilaterally (chronic cheek- or lip-bite keratosis)[3-5]; *4*) constantly rubbing the wisdom teeth in buccal version against the cheek; *5*) constantly rubbing an external object, such as a tobacco pipe, pen cap, or musical instrument; and *6*) presence of removable prosthetic appliances and food impaction on the edentulous alveolar ridge and retromolar pad area.[6,7]

Although the cause of OFK is clear in most cases, clinicians have to include a wide variety of clinical conditions in the differential diagnosis, such as genetic, physiologic, inflammatory, immunologic, potentially malignant, and malignant disorder, or a local insult, including chemical, thermal, or physical irritants.

The main purposes of this investigation were to *1*) inform clinicians and general dentists how frequent OFKs on the facial attached gingival mucosa are, *2*) describe their clinical and histologic characteristics, and *3*) discuss whether these lesions belong to the category of leukoplakia.

## Materials and Methods

This study was a retrospective analysis that reviewed the medical records of 1,654 patients with oral white lesions that were diagnosed and treated at the Oral Medicine Unit, Department of Odontostomatological and Maxillofacial Science of the School of Medicine and Surgery, Federico II University of Naples (Naples, Italy) from 1994 to 2007. The university's institutional review board approved the study design and methods. Patients involved in the study provided a written consent form.

Of all patients studied, only 159 patients, exhibiting white plaque lesions located exclusively on the upper and/or lower facial attached gingival mucosa, were enrolled in the study. These lesions received a provisional clinical definition of "leukoplakia," pending histologic assessment to better categorize these lesions.

Clinical data were collected with regard to the following criteria: *a*) identification of white plaques not removable using sterile gauze, *b*) site and size, *c*) morphology (homogeneity of texture and color), *d*) symptoms, and *e*) history of physical trauma.

All lesions were subjected to incisional biopsy with a conventional scalpel for histologic examination, avoiding exfoliative cytology and brush biopsy. A scalpel biopsy generally allows an accurate diagnosis of such white plaque lesions, providing a specimen adequate for obtaining more detailed histopathologic and immunologic data from the epithelium or the underlying corium. Resected tissues from all cases were fixed in 10% neutral buffered formalin, routinely processed, and embedded in paraffin. Sections (5 $\mu$m thick) were cut and stained by hematoxylin and eosin for conventional light microscopy.

Immunological examinations by direct immunofluorescence, performed to detect immunoglobulin or complement or fibrinogen staining, were just used in case of bilateral lesions, where an autoimmune mucous disease was suspected.

The inclusion criteria encompassed *1*) male and female patients of all races older than 18 years with clinically diagnosed oral white plaque lesions and *2*) the presence of lesions exclusively on the facial attached gingival mucosa. Conversely, the exclusion criteria encompassed *1*) patients who did not satisfy the diagnostic criteria, *2*) patients showing white plaque lesions associated with an erythematous/erosive/ulcerated component, and *3*) patients with keratotic lesions on the edentulous alveolar ridge and/or retromolar pad area, because these last 2 lesions are well-known frequent and distinct clinicopathologic entities.[6,7] Conversely, no data are available in the literature about frictional white plaque lesions located on the facial attached gingiva.

## Results

Of the 159 patients, only 14 (8.8%; 9 men [64.3%] vs 5 women [35.7%]; age range, 32 to 56 years at time of diagnosis; mean, 42.8 $\pm$ 8.5 years) had plaque keratoses of a frictional nature. These lesions occurred in patients in the third to fifth decades (Table 1). Of these 14 patients, 11 (78.6%) showed a unilateral white plaque commonly located on the attached gingiva of 1 tooth or 2 teeth, whereas the other 3 (22.1%) showed bilateral involvement. Of the 14 facial attached gingival lesions, 10 (71.4%) occurred on the maxilla and 4 (28.6%) on the mandibular mucosa. The suspected etiology was an improper toothbrush and brushing technique adopted in 9 patients, a pen cap in 3 patients, and a tobacco pipe and musical instrument in 1 patient (Table 1). All patients were right-handed.

Clinically, in these 14 patients, the lesions appeared as distinct, sharply demarcated, isolated, asymptomatic, homogeneous whitish plaques, with different

**Table 1. CLINICAL INFORMATION ON 14 PATIENTS WITH OFK LOCATED ON THE ATTACHED FACIAL GINGIVAL MUCOSA**

| Patient Number | Age/Gender | Sites of OFK on Gingival Mucosa (Level With Teeth Involved) | Clinical Features of OFK | Suspected Etiology | DIF | Time of Follow-Up (yr) |
|---|---|---|---|---|---|---|
| 1 | 34/F | Facial bilateral upper (14/15 and 24/25) | Rough, irregular, raised | Pen cap | Yes | 5 |
| 2 | 53/F | Facial monolateral upper left (24/25) | Rough, slightly raised | Toothbrush | No | Discontinued |
| 3 | 45/M | Facial monolateral upper left (24) | Rough, slightly raised | Toothbrush | No | Discontinued |
| 4 | 52/M | Facial monolateral upper left (24/25) | Rough, slightly raised | Toothbrush | No | Discontinued |
| 5 | 36/M | Facial monolateral lower (36/37) | Rough, slightly raised | Toothbrush | No | Discontinued |
| 6 | 44/M | Facial bilateral lower (34 and 44) | Smooth, slightly raised | Tobacco-pipe | Yes | 8 |
| 7 | 38/M | Facial monolateral upper left (25) | Rough, slightly raised | Toothbrush | No | Discontinued |
| 8 | 32/F | Facial bilateral upper (13 and 23) | Rough, irregular, raised | Pen cap | Yes | 6 |
| 9 | 48/M | Facial monolateral upper left (25/26) | Rough, slightly raised | Toothbrush | No | Discontinued |
| 10 | 33/M | Facial monolateral upper right (13/14) | Rough, irregular, raised | Pen cap | No | 4 |
| 11 | 54/F | Facial monolateral upper left (25) | Rough, slightly raised | Toothbrush | No | Discontinued |
| 12 | 56/M | Facial monolateral upper left (24/25) | Rough, slightly raised | Toothbrush | No | Discontinued |
| 13 | 35/F | Facial central lower (31/41) | Smooth, slightly raised | Musical instrument | No | 7 |
| 14 | 40/M | Facial monolateral upper left (24) | Rough, slightly raised | Toothbrush | No | Discontinued |

Abbreviations: DIF, direct immunofluorescence; F, female; M, male; OFK, oral frictional keratosis.

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tones, from brilliant white to opaque gray, which affected the facial keratinized gingiva with or without involvement of the papilla and with a variable diameter from 3 to 6 mm. The surface appearance showed different forms: smooth or rough, slightly raised, rarely irregular (Table 1), and not surrounded by erythematous and erosive/bullous areas (Fig 1A-C). Most patients were symptom-free, with the exception of those with aggressive oral habits. In some individuals, a swelling and burning sensation, caused by constant trauma, represented an irritating symptom.

Each patient underwent an incisional biopsy. In patients with bilateral location, 2 biopsies were taken, 1 for each side. Histopathologic examination revealed *1*) a squamous epithelium with a variable degree of hyperorthokeratosis (rarely focal parakeratosis) with mild or moderate surface papillomatosis (Fig 2A); *2*) moderate or prominent hypergranulosis sometimes showing a characteristic inverted triangle pattern (Fig 2B); *3*) acanthosis with elongated, tapered, anastomosing rete ridges (Fig 2A,B); *4*) an intact basal layer; *5*) no feature of dysplasia or malignancy, and *6*) rarely, the presence of a mild chronic inflammatory infiltrate in the underlying corium. Direct immunofluorescence was performed only in those 3 patients with bilateral involvement with a suspected autoimmune etiology, but the results were negative (Table 1). No immunoglobulin or complement or fibrinogen staining was detected.

None of the 14 patients reported a history of alcoholism or use of mouthwashes containing sanguinaria.[8,9] Just 1 of 14 patients (patient 6, Table 1) had a history of pipe smoking, which ceased 10 years before presentation, but nevertheless he reported a history of a continuous trauma on the gingiva due to an improper use of his pipe, as an antistress device.

The disappearance of these gingival white plaques was seen in only 9 (64.2%) of 14 patients after changing the type of toothbrush and brushing technique adopted. No recurrence and/or malignant transformation was seen in these 9 patients who was followed for 2 further years. No malignancy progression was seen in the remaining 5 patients who were followed for 4 to 8 years (Table 1). The resolution of the lesions was not accomplished in these latter patients because they were unable to change their improper oral hab-

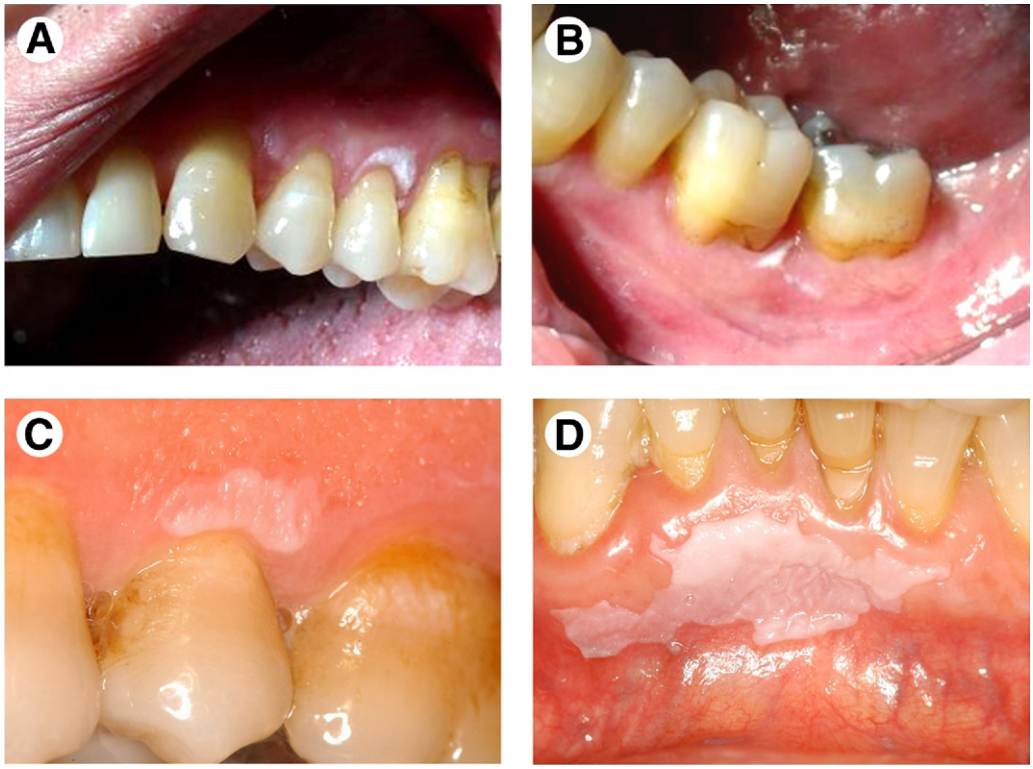


**FIGURE 1.** Clinical features of frictional keratosis in patients (*A*) 5, (*B*) 7, and (*C*) 11, and (*D*) leukoplakia located on the attached facial gingival mucosa. Note the superimposed clinical characteristics of the 2 lesions: flat, homogeneous, isolated, distinct, and well-demarcated white plaques.

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its, although they were repeatedly informed to do so. Therefore, these patients still undergo a periodic follow-up.

Thus, of the overall 1,654 patients, just 0.8% (14 patients) showed white plaque lesions of frictional nature located exclusively on the facial attached gingival mucosa.

## Discussion

The only data available concern frictional keratoses, involving the entire oral cavity. Indeed, 3 previous investigations revealed that of 17,235 noninstitutionalized civilian adults in the United States, the prevalence of OFK was 2.67%,[10] whereas, in the same national survey, of 10,030 children 2 to 17 years, the prevalence of OFK was 0.26%,[11] although these 2 studies lacked histopathologic support. In another extensive survey of 23,616 white American adults from Minnesota, the number of cases of chronic cheek-biting keratosis was 1.2 per 1,000 individuals.[12]

The worldwide situation is very heterogeneous. For instance, in a cohort of elderly Hong Kong Chinese patients, the percentage of OFK was 5% to 7%,[13] whereas in a small study sample of Kenyan adults it was 5.5%.[14] As for Europe, in a Swedish study of 20,333 people 15 years and older, the prevalence of OFK was 5.5%,[15] whereas in Slovenia, the prevalence was 2.2%.[16] Two further investigations performed in Oviedo, Spain, in adults older than 30 years showed that the percentage of OFK ranged from 7.5%[17] to 11.5%,[18] and, last but not least, in Italy the presence of OFK was 9.2%, including traumatic ulcers.[19]

However, 2 recent studies focused attention on frictional keratoses located on a specific site of the oral mucosa, ie, the retromolar pad and alveolar ridge area.[6,7] Conversely, the present investigation focused on the presence of frictional keratoses on the facial attached gingival mucosa.

When a white plaque lesion initially appears on the facial attached gingival mucosa, the clinician should be aware of its clinical appearance when making a preliminary differential diagnosis from among a wide spectrum of such lesions. Indeed, several conditions should be included in the differential diagnosis of OFK, such as chemical burns and acute pseudomembranous candidiasis. Both of these white areas can easily be wiped away using gauze, because they consist of necrotic epithelium (superficial chemical burns)[20] or fungal colonies (acute pseudomembranous candidiasis).[21]

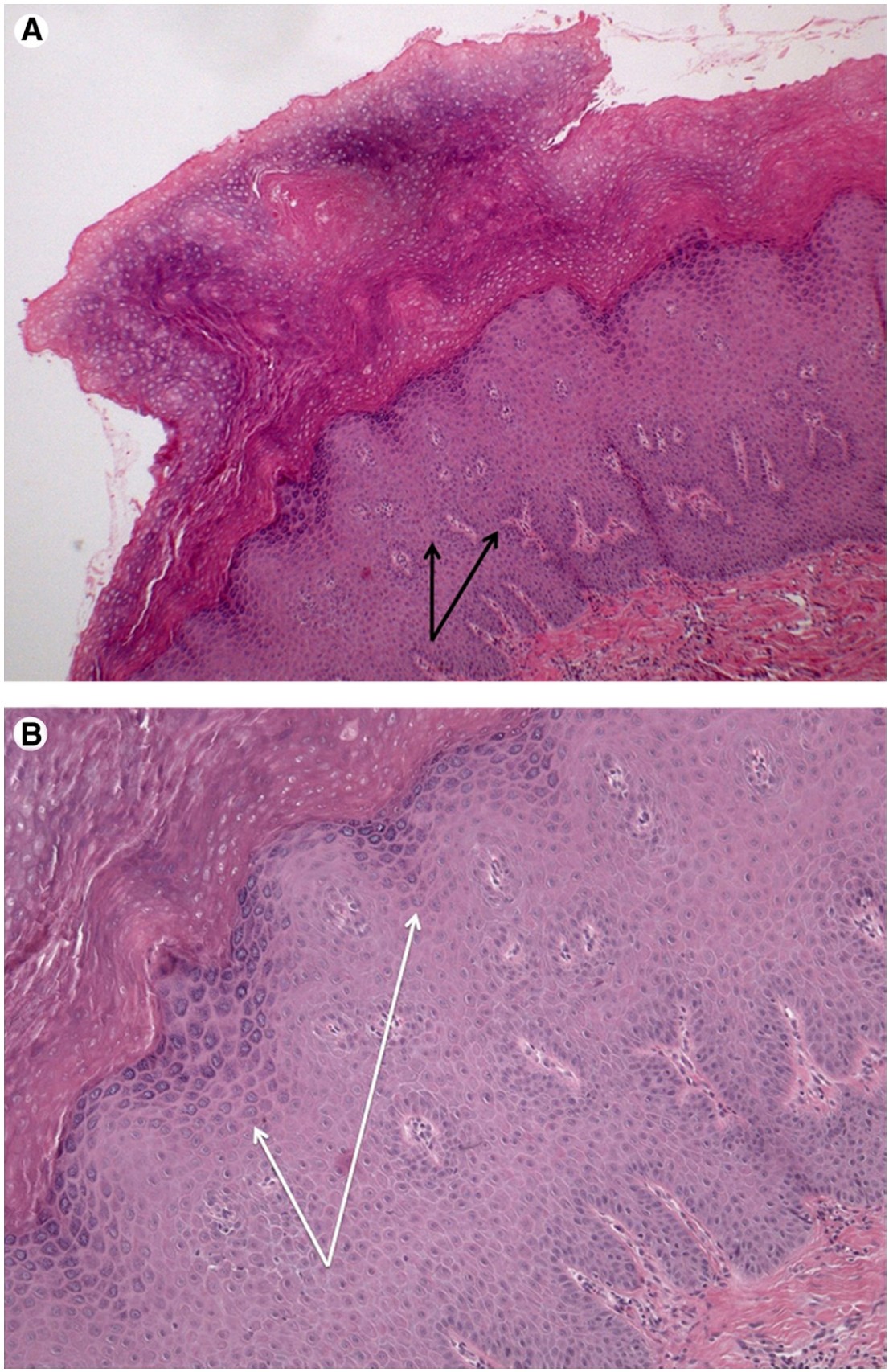


**FIGURE 2.** *A*, Photomicrograph of oral frictional keratosis on the attached facial gingival mucosa revealing a squamous epithelium with marked hyperorthokeratosis, mild papillomatosis, hypergranulosis, and prominent acanthosis with elongated, slender, anastomosing rete ridges (*black arrows*) (hematoxylin and eosin; original magnification, ×40). *B*, Note the characteristic hypergranulosis with its typical inverted triangle pattern, with the base of triangle toward the epithelial surface (*white arrows*) (hematoxylin and eosin; original magnification, ×100).

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Conversely, among the nonremovable white plaque lesions, which may resemble a gingival OFK, it is necessary to take into account genokeratosis, when the lesions are multifocal. Because these conditions are genetic, they commonly appear from childhood. For instance, other than oral involvement, gelatinous plaques of the ocular conjunctiva are peculiar to hereditary benign intraepithelial dyskeratosis,[22] whereas esophageal and anogenital involvements are peculiar to white sponge nevus.[23] In pachyonychia congenita, the characteristic hallmarks are hyperhidrosis, follicular keratosis, and palmar keratoderma.[24] In dyskeratosis congenita, pigmentation of the skin and nail dystrophy are common features,[25] whereas in dyskeratosis follicularis (Darier disease), the oral white plaque lesions are generally accompanied by scaly, warty, crusted papules distributed mostly on the seborrheic areas of the body, with characteristic subungual hyperkeratosis.[26] In focal palmoplantar and oral mucosa hyperkeratosis syndrome, hyperkeratosis of the palms and soles is the main feature.[27]

Similarly, viral lesions, such as nongenital common warts, caused by human papilloma virus infection, should be considered, because they appear as whitish hyperkeratotic elliptical plaques with a rough, irregular and sometimes raised surface, and a variable diameter.[28]

Another distinct and more aggressive clinical entity, which deserves a place in differential diagnosis, is proliferative verrucous leukoplakia (PVL), first described by Hansen et al in 1985.[29] It may present initially as a single flat white keratotic lesion with a grainy or verrucous surface, which is indistinguishable from the other common forms of white plaque lesions, such as frictional keratoses, although it usually spreads to multiple oral cavity sites and shows a recurrent, persistent, and progressive course, with a high percentage of patients developing cancer.[30,31] Even histologically, PVL may show a wide variety of findings, ranging from hyperkeratosis to different degrees of dysplasia to verrucous or squamous cell carcinoma.[30] Recently, a set of major and minor criteria to make a certain diagnosis of PVL was proposed, suggesting a combination of at least 3 major criteria (including histology) or 2 major (including histology) and 2 minor criteria.[32] None of the present patients fulfilled those criteria, thus we easily ruled out a diagnosis of PVL. The most important factor that allowed us to exclude PVL was the long-term follow-up (4 to 8 years). Those patients who showed a persistence of lesions did not show any recurrence, any spreading to other mucosal sites, any progression toward a frank verrucous hallmark, and, most importantly, any malignant transformation.

However, the most common condition, which resembles OFK, is oral leukoplakia. Recently, at a workshop coordinated by the World Health Organization Collaborating Center for Oral Cancer and Precancer in the United Kingdom, this clinical term was defined as "a white plaque of questionable risk having excluded (other) known disease or disorders that carry no increase risk for cancer"[33] and is currently considered a potentially malignant disease.[34] This definition specifically excludes lesions of frictional nature.

Oral leukoplakia is usually asymptomatic and is initially noticed by a dentist during a routine examination. Clinically, it may be characterized by a simple, flat, homogeneous, and sharply delimitated white patch (Fig 1D), with a smooth, wrinkled, or corrugate surface, or a nonhomogeneous speckled plaque with an irregular reddish-gray surface, or by a verrucous aspect with an irregular rough surface. The term *nonhomogenous* may be applied to the color, ie, mixture of white and red changes, or to the texture, ie, exophytic, papillary, or verrucous. It may involve the entire oral mucosa, including the facial attached gingiva, and may occur as a single lesion or as diffuse, often multiple, lesions; the site distribution is partly related to gender and tobacco habits.[35,36]

The histopathologic features are highly variable, from atrophy of the epithelium to hyperplasia, with hyperorthokeratosis or hyperparakeratosis. The granular layer is often thickened and extremely prominent in cases of hyperorthokeratosis, but is seldom observed in severe cases of hyperparakeratosis. Acanthosis may also be observed. The histologic assessment of oral epithelial dysplasia is notoriously unreliable[35,36] owing to the subjectivity of the assessment of the components of epithelial dysplasia as listed by Kramer et al.[37] This would lead, indeed, to a strong interobserver discrepancy between pathologists in the evaluation of the presence and degree of epithelial dysplasia. Thus, the practical value of the grading of epithelial dysplasia, which may vary from mild to severe, turned out to be questionable.[36]

A limitation of the present investigation, performed over a long period in adults, seems to be that the take-home message is not new and, apparently, scientifically unsound: in essence, any clinically white plaque that cannot be wiped off and is located on the facial attached gingival should be temporarily designated clinically as leukoplakia until histopathologic findings disclose its specific nature and establish a definitive diagnosis.

Nonetheless, the present study has some important clinical implications. Although these lesions' clinical aspect mimicked a "true leukoplakia," the microscopic findings confirmed that these lesions were benign reactive hyperkeratoses and did not represent a potentially malignant disease, because they did not show any cellular atypia. Indeed, their histopathologic aspect is superimposable to that of benign alveolar ridge keratosis (BARK), which represents a distinct, benign, and reactive clinicopathologic entity,[7] unlike ARK, which is usually, but not always, benign.[38]

In addition, the medical histories from all 14 patients revealed a specific causative agent. In most cases, the injury to gingival tissue was due to an unsuitable tooth-brushing technique, ie, using a hard-bristled toothbrush or other oral hygiene aids. In some instances, patients related a history of constant scratching with some external object, such as pen caps, a tobacco pipe, or musical instrument. Thus, as with other OFKs, the pathogenesis is traumatic and the treatment consists of removing the etiologic factor.

The diagnosis of an OFK typically consists of a detailed clinical examination, considering the oral habits and possible agents that are involved in the chronic trauma of the oral mucosa. Once a certain diagnosis of OFK has been established, appropriate management of the patient should be initiated. Management is aimed at achieving an adequate indoctrination of patients on removing any frictional irritant surfaces, such as fractured or rough tooth surfaces or dentures with an irregular fit, and discontinuing any incorrect habits, such as biting, sucking, chewing, or scratching. Afterward, the frictional area should be monitored to be certain that it is resolving quickly. In general, the patient should receive the first follow-up 3 weeks after the first visit to assess the possible regression or resolution of the lesion. Eventually, if the putative traumatic factors are eliminated and no resolution of the lesions occurs, it is compulsory to perform adequate follow-up by scheduling an additional biopsy to rule out any dysplastic or neoplastic change over time.

Last, but not less important, the present investigation revealed that these lesions represent an uncommon finding in the oral cavity, unlike an OFK located on the edentulous alveolar ridge and/or retromolar pad area, ie, ARK[6] and BARK,[7] showing a very low frequency (8.8%) on the facial attached gingival mucosa among the nonremovable white plaque lesions.

Considering that such lesions share very similar clinical characteristics with "true leukoplakia" (Fig 1A-D), the frictional nature of these lesions can be established only by histologic and medical history criteria. Although the sample of the study is not so wide, we believe that white plaque lesions on the facial attached gingival mucosa may have a frictional nature. Because these lesions have a specific cause and a peculiar histology, which is superimposable to that of BARK, we believe that frictional keratoses located on the facial attached gingiva must be removed from the category of leukoplakia. This finding helps us to better define oral leukoplakia with more stringent criteria.

It is mandatory to pay particular attention to such lesions, because they are clinically indistinguishable from "true leukoplakia" but histologically show a benign and reactive nature. Whether these can be considered a variant of BARK, because of their superimposed histologic features, remains an open question to be addressed to the scientific community.

Clinicians and general dentists should be informed that it is unlikely that an isolated nonremovable white plaque lesion located exclusively on the facial attached gingiva might have a frictional nature; thus, more thorough investigations need to be performed when these are detected for a proper clinical differential diagnosis with respect to the other white plaque lesions, such as "true leukoplakia," which may not always have a benign course, because of a propensity for malignant transformation.

In summary, together these findings indicate that frictional keratoses on the facial attached gingival mucosa *1*) are rare findings, *2*) clinically resemble "true leukoplakia" but histologically have the same features as BARK, *3*) have no propensity for malignant transformation, *4*) have a good prognosis, and *5*) have a specific cause, and resolution is accomplished if the frictional element is eliminated. Thus, these lesions must be removed from the category of leukoplakia.

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