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Clinicopathological characteristics of tongue piercing: an experimental study

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BACKGROUND: This study attempts to remedy the situation that no morphological studies exit of tongue piercing.
METHODS: The tongues of eight Beagles were pierced with titanium implants. The animals were then divided into four groups: 1 week, 2 weeks, 1 month and 3 months for clinical-photographic and histopathological studies.
RESULTS: Group I: clinically, erythema at both orifices and, microscopically, granulation tissue covering the surface of the canal and infiltrates of polynuclear neutrophils. Group II: persistence of erythema and of the granulation tissue, with the edges of the epithelium showing signs of regeneration. Group III: granulation tissue alternating with fibrosis; epithelium covering the sides of the canal. Group IV: fibrosis substituting the granulation tissue and almost complete re-epithelialization of the canal. All groups, except group I, numerous foreign body-type granulomas.
CONCLUSIONS: Tongue piercing provokes fibrous reparation with almost total re-epithelialization of the perforated zone and foreign body-like granulomatous inflammation.
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Introduction

The modification of one's physical appearance may be considered as a form of self-expression providing information concerning the group to which the subject belongs or wishes to belong, his/her age, status, personality, etc (1–3). One such physical modification, which has long existed as a manifestation of religious/cultural identity (4, 5), is perforation of the skin and mucous membranes to wear adornments such as rings, balls, chains, etc. To modern youth this practice is an outward sign of provocation, rebelliousness, distinction, sexual attraction and even mental disturbance (6).

Among western teenagers, this practice, known as piercing, which lies half way between beauty treatment and mutilation (7), has in recent years undergone a boom. According to Makkai et al. (8), 8% of the Australian population are now affected if one excludes ear piercing, and as many as 50% of students (6). The mouth cavity has become one of the most common body areas for perforation, with the lips, cheeks and even uvula being popular sites, although by far the most common site is the tongue, which represents 16% of piercings in women and 4% in men (9–11). The implant usually consists of a barbell with two screw-on balls made of vanadium, nickel, copper or other metals, although the prevalence of allergic reactions has led to titanium being increasingly used because of its superior bio-compatibility.

Piercing is not free of risk, as several studies have shown and although most injuries are slight and reversible, sometimes they are more serious (12) and may even be life-threatening (13). Reports on the frequency of complications vary greatly (14–17) and while some authors [Greiff et al. (18) and Campbell et al. (19)] mention that 70% of wearers are affected, others [Mayers et al. (6)] mention a figure of 17%. Complications may be local or general, infectious or not but generally associated with two factors. The first of these is the quality of the material used and the skill of the operator concerned, with adequate disinfection being the best method of prevention; secondly the trauma involved in implantation and the nature of the tissues involved. However, the bibliography consulted mainly consists of epidemiological and clinical studies, and no study seems to have attempted to ascertain the morphological alterations involved in tongue piercing, or to have undertaken experiments in animals.

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The object of our study, therefore, was to establish an experimental model of tongue piercing in dogs in order to study the clinical and pathological characteristics at different times post-implant.

Materials and methods

The experiment involved eight Beagle dogs, which were being used in another experiment consisting of implanting different sealing cements in their tibias in order to study the osseous response. The piercing involved placing an implant in the tongue, consisting of a 2 cm long × 3 mm diameter titanium bar, to the ends of which two balls were screwed to form a barbell. The operation was carried out in the experimental operating surgery of the Laboratory Animal Service of the University of Murcia (Licence n° 30030 2AB of the Ministry of Agriculture, Fisheries and Food. Law 13.10.88) and was reviewed by the appropriate institutional committee.

The day before the implantation, the dogs were fed a carbohydrate-rich diet. After anesthesia with 20 mg/kg of Ketolar® (Parke-Davis, Barcelona, Spain) and disinfecting the area to be treated (the thick region immediately behind the middle part of the tongue and immediately before the frenulum, thus avoiding the large blood vessels in this zone), the implant was placed in position by a conventional technique using an Abocat® (Abbott Ireland, Sligo, Republic of Ireland), which consists of a 0.5 mm needle containing a plastic capillary. After perforating the tongue, the bar was introduced and the plastic withdrawn. The operation finished with the two balls being screwed onto the ends of the bar.

The dogs were distributed into four groups, two per group, according to the duration of the implants: 1 week (group I), 2 weeks (group II), 1 month (group III) and 3 months (group IV). During this time periodical clinical-photographic studies were made. At the end of the above times, the animals were sacrificed by the administration of sodium pentotal and a macroscopic examination was made of all the organs. The tongues were dissected out and fixed in 10% buffered neutral formol for 48 h. They were then sectioned dorso-ventrally following the direction of the implanted bar and then processed in the conventional way for inclusion in paraffin. They were sectioned at 3 μm and stained with eosin-hematoxylin and Masson's trichromic for optical microscopic and photographic study.

Results

None of the eight implants produced any important degree of edema or hemorrhaging. The most relevant clinical-pathological characteristics were as follows:

Group I (7 days post-implant): clinically, a large area of erythema with slight swelling surrounding both dorsal and ventral orifices under the two balls of the implant. These patches showed numerous bright red points, which bled at the slightest touch and small accumulations of whitish friable-looking material.

Microscopically, the above corresponded to the presence of young granulation tissue which, from the edge of the squamous epithelium and uninterruptedly, lined the whole length of the canal through which the implanted bar ran. In the uppermost zones, deposits of fibrin and extensive infiltrates of neutrophils and macrophages together with abundant nucleus remains could be seen. The squamous epithelium lining the first past of the canal and the orifices also showed infiltrates of neutrophils and frequent keratinocytes in mitosis (Fig. 1).

Group II (15 days post-implant): the clinical-pathological appearance was similar to that of the above group, although the erythematous area was more homogenous and less prone to bleeding when rubbed.

Microscopically, as in the previous group, granulation tissue predominated both around the orifices and along the canal, although the capillaries were better organized and there were fewer individual endothelial cells; the fibroblasts were mainly spindle-shaped with frequent rather disorganized collagenous fibers between them. Superficial infiltrates of lymphocytes and plasmatic cells extended among the adjacent muscular fibers in an irregular way. At the epithelium edges, it was common to see keratinocytes in mitosis with thin extensions of the epithelium towards the canal.

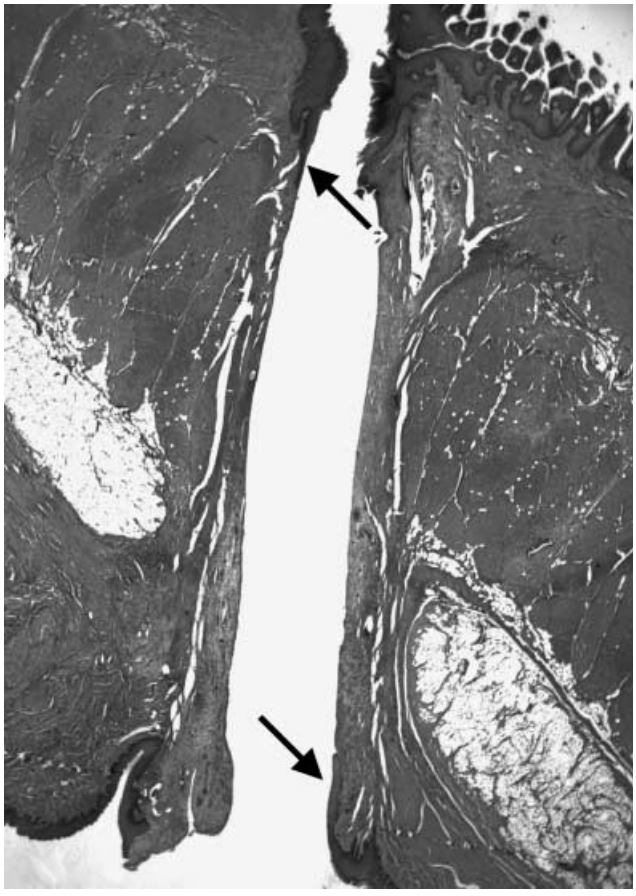

Figure 1 Group I. Overview of canal (upper, dorsal edge and lower, ventral edge of the tongue) covered by granulation tissue and squamous epithelium in the proximal parts (arrows). HE, ×12.5.

Group III (1 month post-implant): clinically, the erythematous areas around the orifices persisted although it was now less swollen and raised. The bright red points of the previous groups were absent, although the traces of the piercing in the tissue were still visible.

Microscopically, old granulation tissue lined the orifices and the canal, which was characterized by numerous collagenous fibers usually in bundles with extensive extracellular matrix between them. Frequent spindle-shaped fibroblasts, abundant blood vessels of capillary caliber and very few isolated endothelial cells could be seen. The infiltrates were predominantly of lymphocytes and plasmatic cells with few polynuclear neutrophils. These infiltrates spread irregularly among the adjacent muscle fibers. Squamous epithelium covered most of the canal on both sides of the tongue in the perforated area (Fig. 2).

Group IV (3 months post-implant): the erythematous zone present in the previous groups was absent, although the area was still distinguishable from the adjacent tissue by its whitish-pink color. The papillae on the dorsal side of the tongue showed some degree of atrophy.

Microscopically, the granulation tissue present in all the previous groups had been almost totally replaced by fibrosis, which in many places spread between the adjacent muscle bundles, where small extensions of randomly organized lymphoplasmocytic infiltrates persisted (Fig. 3). The squamous epithelium covered entire surface of the canal except a central area of one of the sides. This epithelium showed a lover number of cell layers than in the rest of the tongue surface and is thread-like papillae (Fig. 4).

In groups II, III and IV, the presence of abundant foreign-body granulomas was a constant feature in the heart of the granulation tissue, among the adjacent muscle fibers and under the regenerated epithelium at the canal edges. These granulomas were made up of numerous epitheloid-looking macrophages and giant foreign-body type multinucleated cells surrounding the keratinocytes fragments of hair follicle roots, and numerous lymphocytes and plasmatic cells. Some granulomas also showed accumulations of polynuclear neutrophils, usually in the central areas, while others showed small accumulations of homogenous eosinophilous material (instead of keratinocytes remains) among the macrophages and giant multinucleated cells (Fig. 5).

Discussion

The aspects of greatest medical concern resulting from the practice of tongue piercing are, in our opinion, the

Figure 2 Group III. Detail of regenerated epithelium covering most of the canal. HE, ×12.5.

Figure 3 Group IV. Regenerated squamous epithelium covering all the canal except the central part of the left side (arrow). HE, ×12.5.

Figure 4 Detail of Fig. 3. HE, ×312.5.

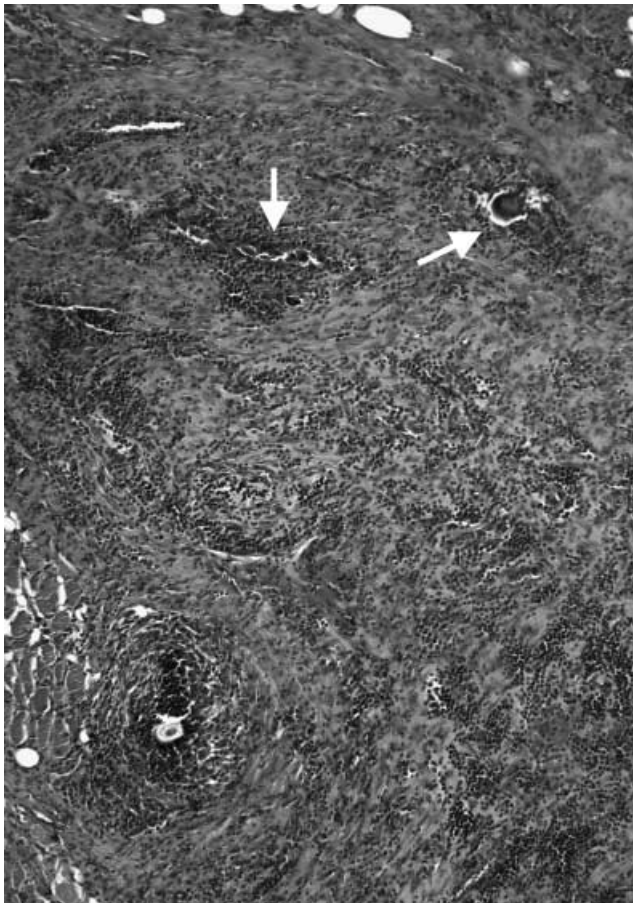

Figure 5 Granulomas around cornified material with frequent giant multipolynucleated foreign body like cells. HE, ×125.

possible complications that may arise. These fall into two types, the local and the general.

Local

This may involve pain, edema and hemorrhage, which are frequent and occasionally serious as the tongue is a very vascularized organ (20); infection, because of the large number of bacteria present in the mouth, especially in diabetics, the immunodepressed and other group. The revision made by Guiard-Schmid et al. (16) describes infections in 10–20% of cases, mainly because of the presence of *Staphylococcus aureus*, *Streptococcus A* and *Pseudomonas Sp*. Tongue abscesses (21) have also been described and even Ludwig's angina (22) caused by anerobic germs. Allergies, too, may arise as a result of the materials used (23–25), together with dental alterations, the continuous banging of the implant chipping and fracturing teeth, particularly those that have been previously treated (15, 26, 27); and alterations of the periodontal tissues, leading to periodontitis and gingivitis, gingival recessions (28–30), etc. Piercing may also stimulate the production of saliva and interfere with vocalization, mastication and swallowing (15). Radiological studies may also be affected (31).

General

Such complications, which have been thoroughly revised by Tweeten and Rickman (14), are usually infectious. Of particular note is infectious endocarditis, as the wound resulting from the implant permits oral bacteria to enter the blood stream, colonizing the endocardium (usually in cardiac patients) and, more rarely, other organs. Such risks increase when antiseptic measures fail (32, 33), other infectious complications (16) including hepatitis A and B, herpes and even HIV according to Pugatch et al. (34). However, we observed no significant edema or hemorrhagic phenomena, and none of the complications described above.

Clinically and pathologically, the morphological substrate of tongue piercing observed in our 3-month study corresponded to the lesions observed during the healing of second intention wounds, that is, those wounds characterized by the loss of tissues made up of permanent cells or with no capacity to divide, such as the muscular tissue of the tongue, with healing consisted of a fibrosis of the sectioned or scarred zone. The process usually begins with acute inflammation accompanied by abundant neutrophilous and macrophagic polynuclear leucocytes, which phagocytize the cell and tissue remains, numerous neo-formed blood vessels of

capillary size, which will constitute the young granulation tissue covering the wound during the first period. After 15 days (group II), this covering is formed of an older granulation tissue as it shows a predominance of collagenous fibers, which, in the following stages (at 1 and 3 months, groups III and IV, respectively) form areas of irregular fibrosis extending among the adjacent muscle fibers.

At the end of the study (3 months), although the canal through which the implant passed had been totally re-epithelialized at the expense of the healthy epithelium at the edge of the surgical wound, the new epithelial covering was not total as a central area on one side of the canal was still covered by fibrino-necrotic remains.

We suggest two possible mechanisms to explain this observation. (i) Repetitive epithelial necrosis because of continuous mechanical pressure from the implant on the newly formed epithelium, or (ii) the persistence of a chronic inflammatory reaction during the period of observation as, after 15 days (group II), all the tongues showed multiple foci of chronic inflammation and the formation of foreign body-type granulomas because of the keratin from licked hairs and food remains, which would favor areas of variably and progressively spreading fibrosis. In our model, this was the most significant complication as, if it continued, it would alter the normal functioning of the tongue and perhaps condition alterations in epithelial growth, as both inflammation and progressive mesenchymal proliferation could influence the normal interaction between mesenchymal and epithelial cells, which many authors have described as being responsible for normal tissue homeostasis in the mouth [Mackenzie et al. (35), Smola et al. (36), Szabowski et al. (37), Mckeown et al. (38)]. These mechanisms might affect the normal growth of the covering epithelium as described by Gao et al. (39) on relation with periapical lesions. In the bibliography, we have found only one reference to a histopathological study of piercing in the mouth and this, too, described the existence of a granulomatose reaction, although of a sarcoidal type (5).

Long-term experiments would be of interest to follow the final stages of the reparative process and possible complications; a larger number of animals would also be useful to make a weekly study of the inter-relation between mesenchymal and epithelial cells during the re-epithelialization of tongues.

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