SHORT COMMUNICATION

Microvasucular architecture in two distinct gingival regions divided by an accumulation of dental calculus

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Introduction

In concurrent studies of oral microvasculature in our laboratory, we have been observing basic vascular architecture in gingiva^{1,2)}, comparisons of the distribution patterns of sub-inner marginal epithelial vascular networks between normal states³⁻⁵⁾ and those under plaque control conditions⁶⁾, as well as the embryological development of these networks⁷⁾ in canines by using resin casts and SEM. Among these studies, we were presented a case in which the vascular network in the buccal gingiva was bilaterally divided into separate regions. A review of presurgery records showed that a large piece of dental calculus had accumulated and adhered to the buccal gingiva of this dog.

The microvascular architecture observed in the two distinct gingival regions on either side of the dental calculus accumulation were examined three-dimensionally under SEM.

Materials and Methods

The microvascular corrosion casting specimen in question was obtained from a male mongrel dog, weighing 8 kg, with dental calculus growth covering 2/3 of the surface area of the buccal gingiva of the

bilateral fourth maxillary premolar. The method used was as described previously by Kishi *et al*⁷⁾. Only half of this corrosion casting specimen was available for observation since the other half had been used in a previous study immediately upon solidification of the resin.

Results

Figure 1 shows a general view of the gingival microvascular corrosion cast of the maxillary premolars observed from the palatine side and clearly illustrates the vascular network in the buccal gingiva of the fourth premolar divided into separate regions. The partition between the two regions extended continuously about 14.3 mm and had a 3 mm wide gap with a maximum depth of 1.4 mm, suggesting that the buccal gingiva had been divided into two.

To distinguish the vascular network appearing in the two separate regions of the buccal gingiva, the region between the tooth crown and the dental calculus was referred to as the "bucco-crown side gingiva" (BCG in Fig.1), while the other region between the dental calculus and the oral epithelium was referred to as the "bucco-oral cavity side gingiva" (BOG in Fig. 1). These vascular networks were further classified as the dental calculus side and the crown side in BCG, and the calculus side and the cavity side in BOG,

Fig. 1 Gingival vascular resin cast of maxillary left fourth premolar (PM₄), showing that the buccal gingiva had been divided into two separate regions, bucco-crown side gingiva (BCG) and bucco-oral cavity side gingiva (BOG). (*) means the space of dental calculus. The arrows (← Fig. 2~4) indicate the angles from which the gingiva were being observed. PM₃ : third premolar, M₁ : first molar.

respectively.

1. The vascular network of the bucco-crown side gingiva (BCG)

1) The crown side :

The diameters of the capillaries forming the vascular network in the part of the calculus covered locus (① in Fig. 2) were dilated up to 2~2.5 times larger than those seen in normal gingiva on resin casts. The capillaries meandered randomly and formed anastomoses in a jumbled fashion (as a spherical globular

shape). Both produced an increased vascular distribution density. Moreover, considerable resin that had leaked from the vessels was also observed (Le in Fig. 2). The lower margin of this capillary network was without a distinct boundary to the periodontal vascular network.

In contrast, the capillaries forming the vascular network of the normal gingiva adjacent to the calculus covered locus (② in Fig. 2) were slightly dilated. The marginal portion in this region was filled with hairpin shaped capillary loops, while the lower half was enmeshed with a fishnet-like capillary network which was not markedly dilated. In spite of the lower margin of this network (LM in Fig. 2) running irregularly in wavy patterns, its boundary between the adjacent periodontal vascular network was clearly distinguishable.

2) The dental calculus side :

Figure 3 exhibited the vascular network in the same preparation as used in Figure 2, observed from the dental calculus side. The vascular network consisted mainly of a flat fishnet-like capillary network, however, the capillaries comprising the network were found to be slightly dilated and the distribution density was also higher and more irregular in terms of original distribution pattern, resulting in a network of deformed meshes (① in Fig. 3). A vascular network exhibiting a spherical, globular shape with foot-like projections was also observed in some areas (GS in Fig. 3). Approaching the gingival margin, the vascular network changed its distribution pattern from a fishnet shape to a short, hairpin shape and the dilation of the capillaries were found to be more severe.

The distal part of the calculus covered locus presented a palisade-like shape, and which was characterized by the appearance of dilated venules and severed capillaries (② in Fig. 3).

2. The vascular network in the bucco-oral cavity side gingiva (BOG)

1) The dental calculus side :

Figure 4 shows the vascular network of the center region of the dental calculus covered locus observed from the dental calculus side. Although a fishnet-like capillary network similar to that shown in Figure 3 ①

Fig. 2 Vascular network of the crown side in BCG. (*) means the space of dental calculus. ① and ② in figure shows the capillary network in the part of calculus-covered locus and normal gingiva. DM : distal margin of the dental calculus, Le : leakage of the resin from vessels, LM : lower margin of the capillary network. Bar represents 100 μ m

Fig. 3 Vascular network of the dental calculus side in BCG. The same preparation used in Figure 2. ① and ② in figure shows the capillary network in the part of central and distal portion, and ③ exhibits the gingival capillary loops of the oral cavity side in normal gingiva. DM : distal margin of the dental calculus, Le : leakage of the resin from vessels. GI : globular shape capillary network. Bar represents 100 μ m

Fig. 4 Vascular network of the dental calculus side in BOG. Bar represents 100 μ m

was distributed in some areas, the vessels running toward the upper margin of this region were hairpin shaped.

2) The oral cavity side :

We could not remove the previous specimen from the SEM stage.

Discussion

To our knowledge, this type of case in which the gingiva had been divided by dental calculus, has not been previously reported. It is hypothesized that this type of unusual accumulation of dental calculus taking place in such a highly specific location as the buccal surface of the upper fourth premolar may be largely due to the characteristic shape of the crown of the canine teeth. There is a particularly well-developed cervical ridge on the premolar, forming a deep indentation under the ridge. Additionally, because the buccal surface of the upper fourth premolar is adjacent to the opening of the parotid duct it may also prompt calculus accumulation in this area.

The vascular architecture of microcirculation is known to be tissue specific. However, in reacting to an acute or chronic inflammation, there is a common pattern in the development of vascular architecture. The blood vessels generally respond to a stimulus as follows : ① increase in diameter, ② meandering extension with as increase in the number of anastomosis vasorum, ③ dilation in the endothelial gaps and ④ either an increase or decrease in their distribution densities per unit area. It has generally been suggested that there is a correlation between the severity of inflammation and the progress of the side-growth of gingival epithelial cells. The remodeling of the microvascular network is also known to occur in relation to the intensity of irritation. Conversely, the severity of gingival inflammation can be detected by examining the distribution patterns of vascular networks shown in the corrosion preparations.

From this point of view, the observations described above suggest that the intensity of the irritation seen in this study may have a slightly irritation as evidenced by the presence of two distinct regions within the calculus covered gingiva (Fig. 3, 4). In addition, the crown side in the calculus covered gingiva (① in Fig. 2) which is the same portion as the inner marginal epithelium, strongly suggests that this region had suffered from major irritation. Normal gingiva (② in Fig. 2) close to the calculus covered gingiva may reflect that this area remained relatively stable with only minor inflammation, although it can be presumed that this condition would have soon progressed to a more serious stage.

In conclusion, contrary to our initial hypothesis, the changes in the vascular architecture seen in the calculus covered locus suggest that the intensity of irritation is a relatively minor factor. A histopathological study should be performed if any similar cases become available in future.

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