Morphological study of the vasa nervorum in the peripheral branch of human facial nerve

By

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Abstract: Given the length of axons reaching to distal regions, all peripheral nerves must derive nutrient supply not only for the nerve cell body, but also for the peripheral parts. Along the course of a peripheral nerve, in general, nutrient vessels accompany nerve fibers to peripheral regions in the form of “vasa nervorum” derived from the epineurium, reaching the endoneurium through the perineurium and forming a capillary plexus. In addition, in reconstructive procedures in plastic surgery, anastomosis of not only nerves, but also the vasa nervorum, has been reported to achieve improved outcomes. The present study therefore observed morphological features of the blood supply to the distal portion of the facial nerve in 14 sides of 14 adult cadavers (age at death, 46–86 years) under stereo microscopy after dye injection. The region of the epineurium was also observed under scanning electron microscopy (SEM). The vasa nervorum was seen to derive from a complex reticulation structure formed mainly by the superficial temporal, facial, transverse facial and zygomatico-orbital arteries with collateral supply from the supra-orbital, deep temporal, buccal arteries and parotid branches. SEM showed that one capillary accompanied each perineurium in each nerve fascicle.

Key Words: anatomy, morphology, vasa nervorum, facial nerve, nutrient supply

Introduction

Nutrient supply to nerves comes not only from the nerve cell body, but also from the blood vessels that course along the nerve fibers. In particular, for peripheral nerves with long axons, the accompanying blood vessels represent an important source of nutrients. These blood vessels that supply nutrients to nerves are known as the “vasa nervorum”. The structure of these blood vessels includes branches in the epineurium, with formation of capillary networks from the perineurium to the endoneurium; and from these, nutrients are supplied to the nerve fibers.¹–⁶

Adams¹ described and discussed that the vasa nervorum was first reported by Isenflamm and Doerfler (1768), first described in an anatomy textbook by Bichat (1830). Adams¹ also described that studies on the vasa nervorum were performed by Hyrtl (1859, 1864) and Quénu and Lejars (1890, 1892, 1894). In these reports, the vasa nervorum was described as follows. (1) Along with nerves in subcutaneous tissues, accompanying arterial networks are present in subcutaneous tissue and freely communicating arteries. (2) Nutrient supply to nerves is not just from a single artery, but rather from multiple blood vessels in the periphery. (3) These blood vessels always originate from specific larger blood vessels. (4) Nutrient arteries run diagonally or wind near nerves, then after coursing for some distance along the nerve surface, enter these nerves as ascending or descending branches. Branching blood vessels are always present before the vessel enters the nerves. Moreover, Hyrtl (1859, 1864) reported that sometimes, blood vessel branches can enter the nerves without bifurcation.

With regard to studies on the vasa nervorum of cranial nerves, Bartholdy² performed studies from the olfactory nerve to hypoglossal nerve, reporting macroscopic observations of the distribution of blood vessels accompanying the cranial nerves. However, details on sites without accompanying blood vessels and distal portions of each nerve were not reported. In Japan, Konno³ examined the sciatic nerve, brachial plexus, and vagus nerve, Kinoshita⁴ examined the trigeminal nerve, and Ozawa⁵ examined the glossopharyngeal nerve. Using gross anatomical techniques, they observed the vasa nervorum from the proximal portion to distal portion of each nerve. In addition,
with a focus on the vasa nervorum of the facial nerve, many studies\(^6,7\), including one by Blunt\(^8\), have been conducted on sites from centrally to the facial nerve canal in the temporal bone. To date, no reports have described peripheral branches exiting the stylomastoid foramen and distributing to the muscles of facial expression.

Therefore, as part of research on the facial nerve, we examined the vasa nervorum supplying branches of the distal portion of the facial nerve.

**Materials and Methods**

1. **Materials**

Cadavers donated for medical education (age range at death, 46–86 years; 8 male sides, 6 female sides) that had been embalmed with 10% formalin and injected with red-colored dye into a femoral artery. Cadavers were stored in the repository of Kagoshima University Graduate School of Medical and Dental Sciences. Consent was obtained from all donors and their relatives for use of the body (including organs, tissues, and cells) for medical research (including anatomical examination, dissection and other similar purposes) and for education. All methods used in this study complied with the Post-mortem Examination and Corpse Preservation Act of Japan.

2. **Methods**

The integument of the face was dissected. While carefully removing the subcutaneous connective tissue and fat, the facial muscles of expression and branches of the facial nerve were exposed. The muscles of facial expression and peripheral tissue were dissected en bloc from the craniofacial bones. From the outer surface and deeper layers, the peripheral branches of the facial nerve and blood vessels in the periphery were exposed and examined macroscopically.

For arteries that appeared to course along nerve fascicles, at sites where it was difficult to macroscopically distinguish between the vasa nervorum that supplied nutrients to nerve fibers and blood vessels that simply ran parallel to the nerves, the morphology of blood vessels that entered the nerves was examined using stereoscopic microscopes (SZX-12, BX-51, and DP-12; Olympus, Tokyo).

In addition, in some specimens, entry of the vasa nervorum into nerve fascicles was examined using scanning electron microscopy (SEM). As preparation for examination, peripheral tissue at the site of blood vessel entry was resected and fixed on a resin plate. After preparation of the neurovascular expanded specimen, treatment with NaOH and collagenase digestion was performed to remove excess connective tissue. These SEM specimens were immersed first in 100% ethanol and then in t-butyl alcohol. Drying was performed using a freeze-drying apparatus (ID-2; Eiko Engineering, Ibaraki), and coated with gold evaporation and a sputter coater (JFC-1100; JEOL, Tokyo). Sections were examined with a scanning electron microscope (acceleration voltage, 5 kV, 50×, JSM-5510LV; JEOL, Tokyo), with special attention given to the morphology found in the nerve fascicles.

**Results**

1. **Artery distribution to each branch (Fig. 2)**

For the facial nerve within the parotid gland and each of its branches (temporal branch, zygomatic branch, buccal branch, marginal mandibular branch, cervical branch)\(^9\), the distribution of blood vessels corresponding to the vasa nervorum was examined.

1) Within the Parotid Gland

Regarding the arterial distribution in the parotid gland, the parotid branch, which is a branch of the superficial temporal arterial distribution in glandular tissue, was also distributed in the periphery of the site where the facial nerve branched into the temporofacial and cervicofacial divisions in the preauricular area of the gland. Among these, the blood vessels accompanying the temporofacial division were in the gland slightly superior to the site where the superficial temporal artery and temporofacial division crossed, and branched from the superficial temporal artery (Fig. 3A). In addition, blood vessels accompanying the cervicofacial division were inferior to the site where the superficial temporal artery and cervicofacial division crossed, and branched inferoanteriorly from the superficial temporal artery. In the parotid gland, like the branching and convergence of the facial nerve, the blood vessels also branched and converged, and tended to course along the nerve surface.

2) Facial Nerve Branches (Table 1)

(a) **Temporal branches**

In the temporal region, small arterial branches mainly from the frontal branch of the superficial temporal artery were observed in a configuration accompanying the temporal branches in 11 of 14 cases. Among these 11 cases, a pattern of small branches from the zygomatico-orbital artery was seen in 7 cases (Fig. 3B), and a pattern of distribution of small branches from both of them were seen in 4 cases. In 1 of 11 cases of distribution of small frontal branches, and in 1 of 7 cases of distribution of small branches of the zygomatico-orbital artery, there was also supply from the zygomaticofacial branch, a branch of the lacrimal artery that passes through the zygomatic bone. These blood vessels that accompanied the temporal branches, and superficial temporal artery branches that accompanied the temporal branches, communicated in the parotid gland. Anteriorly, there was communication with branches of the supra-orbital artery and the anterior deep temporal artery, which perforates the deep temporal
fascia. In all cases, with branching and convergence of temporal branches, the blood vessels also accompanied the nerve distribution.

(b) Zygomatic branches

Blood vessels that accompanied the zygomatic branches were branches from the zygomatico-orbital artery in 7 of 14 cases (Fig. 3C). In 8 of 14 cases, branches from the transverse facial artery were observed. In 2 of these 8 cases, there were overlapping branches from both the zygomatico-orbital artery and transverse facial artery. In addition, in 1 case, the zygomatico-orbital artery was poorly developed, and blood supply in the temporal region was from a frontal branch of the superficial temporal artery. Besides these distributions, in 9 of 14 cases, small arterioles from the zygomaticofacial branch (a branch of the lacrimal artery that passes through the zygomatic canal) also distributed in the deep layers of the lateral portion of the orbital part of the orbicularis oculi muscle.

As the zygomatic branches, from within the parotid gland in the proximal portion and throughout the lateral orbicularis oculi muscle in the distal portion, communicate abundantly with temporal branches, it is difficult to distinguish the boundary between the zygomatic branches and temporal branches. The blood vessels distributed along these branches thus have common branches from

**Table 1. Distributions of Vasa nervorum**

<table>
<thead>
<tr>
<th>mother artery</th>
<th>division</th>
<th>TB</th>
<th>ZB</th>
<th>BB</th>
<th>MB</th>
<th>CB</th>
<th>anastomosis</th>
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<tr>
<td>Superficial temporal artery</td>
<td>direct (Parotid branch)</td>
<td>14</td>
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<td></td>
<td>11</td>
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<td>Supraorbital artery, Supratrochlear artery</td>
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<td>Zygomatico-orbital branch</td>
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<td>Zygomatico-facial artery</td>
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<td>Transverse facial artery</td>
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<td>8</td>
<td>14</td>
<td>1</td>
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<td>Infraciliary artery, Facial artery</td>
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<td>Maxillary artery</td>
<td></td>
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<td>7</td>
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<td>Facial artery, Transverse facial artery</td>
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<td>Buccal artery</td>
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<td>Mental artery</td>
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<td>Inferior labial artery</td>
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<td>Lacrimal artery</td>
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<td>–</td>
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<td>3</td>
<td>14</td>
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<td>Infraorbital artery, Transverse facial artery</td>
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<td>Inferior labial artery</td>
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TB, Temporal branch; ZA, Zygomatic branch; BB, Buccal branch; MB, Marginal mandibular branch; CB, Cervical branch

![Fig. 2](image1.png) ![Fig. 3](image2.png)

**Fig. 1. The location of the figure 2 and Figure 3.**
Fig. 2. Arterial distribution to the facial nerve 1. A) The zygomatico-orbital artery, originating from the superficial temporal artery, is the main supply, with distribution to temporal and zygomatic branches. Distribution to the facial nerve is seen at sites of communication among the parotid branch in the proximal portion, small branches directly originating from the superficial temporal artery, the supraorbital artery in the distal portion, and branches perforating through the temporal fascia from deep inferoanteriorly to the temporal region. B) Buccal branch supplied from the transverse facial artery, which originates from the superficial temporal artery. Distribution to the facial nerve, with communication between the parotid branch in the proximal portion and branches of the facial artery. C) Distribution to the marginal mandibular branch, with communication between branches of the transverse facial artery and facial artery, and formation of a vascular network in superficial layers of the masseteric fascia.

BB, buccal branch; F, facial artery; MB, marginal mandibular branch; MM, masseter muscle; O, orbit; PD, parotid duct; PG, the region of the parotid gland (removed); SM, submandibular gland; ST, superficial temporal artery; TB, temporal branch; TF, transverse facial artery; ZA, zygomatic arch; ZB, zygomatic branch; ZO, zygomatico-orbital artery.
Fig. 3. Arterial distribution to the facial nerve. A) A branch originating from the superficial temporal artery divides into an ascending branch and descending branch, with distribution to the temporal branch. B) Distribution to the temporal branch from arterial branches of the zygomatico-orbital artery, a branch of the superficial temporal artery. C) Distribution to the zygomatic branch from arterial branches of the zygomatico-orbital artery, a branch of the superficial temporal artery. D) Distribution to the buccal branch from small branches of the transverse facial artery, a branch of the superficial temporal artery. E) Distribution to the marginal mandibular branch from branches of the facial artery. F) Distribution to the cervical branch from the parotid branch, a branch of the superficial temporal artery.

Arrows represent coursing blood vessels; BB, buccal branch; CB, cervical branch; FA, facial artery; FB, frontal branch of superficial temporal artery; FV, facial vein (turned); MB, marginal mandibular branch; PD, parotid duct; PG, parotid gland; ST, superficial temporal artery; TB, temporal branch; TF, transverse facial artery; ZO, zygomatico-orbital artery.
the superficial temporal artery within the parotid gland, and common branches from the zygomatico-orbital artery in the distal portion. Regarding these trends, in particular, patterns were observed where buccal branches formed from both the temporofacial and cervicofacial divisions, with communication also between zygomatic branches and buccal branches, and patterns were observed with communication at two or more sites between the temporofacial and cervicofacial divisions. These blood vessels that accompanied the zygomatic branches appeared reticulated as they accompanied the nerves, and communication with the parotid branch of the superficial temporal artery within the parotid gland was seen in the proximal portion.

(c) **Buccal branches**

Along the buccal branches, small arterial branches were observed from the transverse facial artery, which originates from the superficial temporal artery. These blood vessels were also distributed in the parotid duct, which runs closely in parallel with the buccal branches. This configuration, regardless of the degree of development, was seen in all 14 cases (Fig. 3D). In addition, in 5 of the 14 cases, when the transverse facial artery was well developed, communications with the facial artery in the distal portion, and formation of a vascular network in the superficial layers of the masseteric fascia, were observed. Of 9 cases with poor development of the transverse facial artery and no direct communication with the facial artery, 3 cases showed small branches from the facial artery, while the facial artery runs anterior to the masseter muscle. In 1 of 14 cases, a zygomaticofacial branch (a branch of the lacrimal artery that passes through the zygomatic canal), which penetrates the surface from deeply, was observed. One of 14 cases showed branches from the buccal artery. In 5 cases, there was a distribution of blood vessels (anterior masseteric artery) that were branches of the facial artery and ran along the anterior margin of the masseter muscle. Besides these distributions, 7 of 14 cases showed some branches from the infraorbital artery, which exits the infraorbital foramen.

As a configuration of facial nerve branching, the most commonly observed pattern (7 of 14 cases) was “buccal branches formed from both the temporofacial and cervicofacial divisions, with communication between zygomatic and buccal branches.” In this pattern, buccal branches were well developed, with complex anastomoses. The vasa nervorum that supplied nutrients to these branches were also well developed. Blood vessel branches from arteries that coursed in the buccal periphery were observed over a wide area.

(d) **Marginal mandibular branches**

At the site where marginal mandibular branches run anteriorly along the inferior margin of the mandible, accompanying blood vessels similar to those seen with the temporal and zygomatic branches were not clearly observed. Nutrition was received from arteries that branched from vessels from the facial artery or its branches which ran along the anterior margin of the masseter muscle (anterior masseteric artery). These arteries ran superior to the masseteric fascia (Fig. 3E). In all 14 cases observed, at the site of crossing of the facial artery (which crosses the inferior margin of the mandible and runs superiorly in the superficial layer) and marginal mandibular branch (which runs anteriorly), branches from the facial artery accompanied both proximal and distal portions of the marginal mandibular branch. In addition, in 7 of 14 cases, small branches from a vessel ran along the anterior margin of the masseter muscle (anterior masseteric artery): in 2 cases, these were small branches of the inferior labial artery; and in 1 case, these were branches of the transverse facial artery. In the mental region, mental branches were also thought to be involved, but accompaniment of mental branches was clearly observed in only 1 of the 14 cases. In the remaining cases, no obvious branch distribution, other than facial artery branches, could be confirmed.

(e) **Cervical branches**

In all 14 cases, a pattern was observed in which small branches from the superficial temporal artery accompanied the cervicofacial division within the parotid gland, then extended and continued from the parotid gland (Fig. 3F). In 3 cases, due to specimen damage, no obvious branches could be confirmed other than superficial temporal artery branches. Excluding these, in the submandibular region crossing the inferior margin of the mandible, direct branching from the facial artery was seen in 8 of 11 cases, while branches from the submental artery were observed in the remaining 3 cases. In the cervical region, common branches with blood vessels distributed in the platysma muscle were involved, but identification was difficult for arteries below the hyoid bone.

2. Insertion into the epineurium

Using a stereoscopic microscope, blood vessel insertion into nerve fascicles and courses within the nerve fascicle were examined. Several configurations were observed, as described below.

Small arterial branches ran in parallel, close to the nerve fascicle, and branched at near right angles. These branches, while bending and winding, passed through the epineurium, and entered the nerve fascicle (Fig. 4A). Alternatively, just before insertion, vessels bifurcated into 2 branches, and these branches each had an ascending branch and descending branch that then entered the nerve (Fig. 4B). Arteries either ran linearly and in parallel with nerve fascicles, through relatively superficial layers of the nerve, then diverged at a right angle and entered into the epineurium (Fig. 4C), or followed a tortuous course before entry (Fig. 4D, E). In some cases, blood vessels coursing
Vasa nervorum in the peripheral branch of facial nerve

3. Observation using SEM

When the inside of the epineurium was observed from the outer surface, some blood vessels accompanied nerve fibers through the loose connective tissue. Arteries and veins coursed within the epineurium, with the nerve in the center. Some vessels then exited and re-entered (Fig. 5A). On cross-sectional examination of a nerve fascicle, in addition to the blood vessels observed macroscopically, several arteries and veins were seen in the periphery of the nerve fiber. On more detailed examination with chemical treatment, loose connective tissue within the epineurium appeared unraveled, with blood vessels coursing through-

Fig. 4. Arteries entering the epineurium. A) A branch from a coursing artery, without bifurcation into ascending and descending branches, entering alone into the epineurium (buccal branch). B) Two arterial branches, an ascending branch and descending branch, enter the nerve fascicle (temporal branch). C) Artery accompanying nerve for some interval (about 1 mm), then branching at right angles and entering deep into the nerve fascicle (buccal branch). D) Branch from an artery that courses along the nerve, passes through the nerve, and then rejoins the original artery (buccal branch). E) Blood vessel with a complex tortuous course within the nerve fascicle (marginal mandibular branch). P⇒, proximal direction, arrows indicating the furcating points.

Fig. 5. SEM observation. A) Blood vessels coursing through a nerve fascicle surrounded by loose connective tissue. SEM shows the outer surface of the facial nerve and surrounding structures after 6 N NaOH cell-maceration (reaction time, 15 min). B) Artery coursing within perineurium that surrounds the nerve fascicle relatively densely. A single artery courses within the perineurium of a single fascicle. SEM showing the outer surface of the facial nerve and its surrounding structures after 6 N NaOH cell-maceration (reaction time: 15 min). A, artery; Epi, epineurium; N, nerve fiber; V, vein.
out. However, for each single nerve fascicle that was relatively well preserved and surrounded by perineurium, a single artery was seen coursing within the perineurium (Fig. 5B).

**Discussion**

When considering the treatment of peripheral nerves, knowledge about the blood vessels that supply nutrients to these nerves, namely, the vasa nervorum, is important. Blood vessel distributions in the periphery serve as a source of nutrients to the nerve and must be considered. The vasa nervorum includes arteries and veins, but veins are hard to observe because the walls are thin and dye entry is difficult. This study thus investigated the vasa nervorum of peripheral branches of the facial nerve in the same manner as previous studies\(^3\)–\(^5\), examining only arteries.

Regarding the vasa nervorum of cranial nerves, Bartholdy\(^2\), in a report on all cranial nerves from the olfactory nerve to the hypoglossal nerve, stated that the major nutrient vessels were the same-named blood vessels, but the vasa nervorum, other than these blood vessels, was not described in detail. Regarding the vasa nervorum of the facial nerve, which was examined in our study, Blunt\(^6\) has previously reported on the status within the temporal bone, but peripheral branches after exiting from the facial nerve canal were not discussed. On the other hand, Tobin\(^10\) injected latex and vinylite in arteries distributed to the face and investigated the blood supply of nerves. According to that report, branches of the facial nerve receive branches of arteries adjacent to the exit from the parotid gland. That is, nutrition is supplied from arteries that accompany these nerves distributed to the muscles of facial expression. Finally, after the nerves enter the muscles of facial expression, they still receive nutrition from arterial branches that supply nutrients to each muscle. In the present study, based on our observed results, nutrient supply was received from glandular branches of the superficial temporal artery, which were distributed within the glandular tissue itself, even before exiting from the parotid gland.

Regarding the transverse facial artery, Yang et al.\(^11\) found perforating branches to the superficial layers of the skin, branching of the vasa nervorum, and distribution to the parotid duct and muscles. During their course, vessels accompanying the zygomatic branch were usually seen. Based on our observations, in terms of vasa nervorum supply, there was more prominent involvement with the buccal branch, compared to the zygomatic branch.

In this study, we also observed patterns of entry of the vasa nervorum into the facial nerve. Konno\(^3\) observed entry of the vasa nervorum into the sciatic nerve, identifying 7 types based on blood vessel size and number of branches. In type I, after entering the nerve, the artery bifurcates into an ascending branch and a descending branch, or there is a single ascending or descending branch that continues its course. In type II, before entry of the artery into the nerve, there are already two branches: one enters as an ascending branch, and the other as a descending branch. In type III, one or two branches arise before entry of the artery, with each entering the nerve. In type IV, one artery enters the nerve, then exits the nerve after descending and coursing in the nerve for a few centimeters, with distribution to muscle or other structures. While coursing through the nerve, several small branches are given off. In type V, the artery that is going to enter the nerve only enters after giving off vasa nervorum at its root. In type VI, a single relatively large artery joins with a similar size artery in the nerve. In type VII, a single arteriole joins a central artery or arteriole within the nerve.

Our observations of the facial nerve revealed one type in which a single blood vessel entered the nerve, and one type where two branches were created just before entry into the nerve. In other words, we only observed relatively simple patterns of type I and type II (Fig. 4A, B). In the vasa nervorum of the sciatic nerve, there is often a type with entry of 5–10 arterial branches into the nerve. In the vasa nervorum of the trigeminal nerve, 1–2 vessels are common, as reported by Kinoshita\(^4\), but detailed patterns were not mentioned. The sciatic nerve has a wide distribution and the largest nerve fascicles in the human body. As large amounts of nutrition must be supplied to these nerve fascicles, and because of the entry of blood vessels into nerves in various patterns at each site, various differences in patterns may be observed. In contrast, for cranial nerves such as the facial, trigeminal, and glossopharyngeal nerves, distribution is limited to the head, and the vasa nervorum is supplied from a relatively smaller area, so short blood vessels from the periphery entering the nerves are sufficient. This accounts for the observed results in our study.

Mackenzie et al.\(^12\) used cast specimens of rat blood vessels to examine the vasa nervorum coursing through the epineurium, perineurium, and endoneurium, including the course of direction and size. They reported a diagonal course of blood vessels in the perineurium. Comparing the results with humans, SEM observations in the present study allowed observation of the vasculature outside the nerve fascicle. This vasculature was about the same size as the nerve fascicle (0.1–0.2 mm), and ran outside the perineurium, along the long axis of the nerve. Somewhat smaller vasculature was evident inside the nerve fascicle, running through the perineurium. This vasculature inside and outside the nerve fascicle, in terms of a network of communicating branches passing through the perineurium, may not be morphologically much different from that in small animals.

With regard to the relationship between blood supply and nerve paralysis, Konno\(^3\) morphologically examined
We thus find it difficult to accept that “numbness” occurs due to ischemia of the sciatic nerve, as described by ttered, with extensive distribution of the vasa nervorum. Konno3). We consider the results reported by Kinoshita4) the facial nerve anastomosed with each other, forming a nerve paralysis. From our observations, branches of peripheral nerve, in addition to nutrient supply from neurons themselves, nutrient supply from blood vessels in the distal portion was reported. The cause of so-called “numbness” was thought to be mainly due to ischemia resulting from compression of the vasa nervorum, rather than compression of the nerve itself. Based on observations of the vasa nervorum of the trigeminal nerve, Kinoshita4) believed that nerve paralysis could not be completely explained based on ischemia of the vasa nervorum alone. In a study of facial nerve vasa nervorum, Blunt6) also stated that abnormal blood supply alone was not the cause of the nerve paralysis. From our observations, branches of the facial nerve anastomosed with each other, forming a network-like structure, and adjacent arteries mutually entered, with extensive distribution of the vasa nervorum. We thus find it difficult to accept that “numbness” occurs due to ischemia of the sciatic nerve, as described by Konno5). We consider the results reported by Kinoshita and Blunt6) as more valid.

Considering the above from a comprehensive clinical perspective, the vasa nervorum is important in the fields of plastic surgery and oral surgery. As an example, much research has been undertaken, including that by Taylor et al.10, on nerve grafts in which the peripheral nerve vasa nervorum is preserved. In particular, in facial reconstructive surgery, vascularized nerve flaps and facial nerve grafts from the unaffected side have been used in patients with facial nerve paralysis after tumor excision, achieving good outcomes14). These operative techniques are based on the morphological characteristics that peripheral nerves receive blood supply from blood vessels that run parallel or segmentally to the long axis, and from muscle-perforating branches in the periphery, and that this vasculature is present both outside and inside nerve fascicles, with a network of communicating branches that pass through the perineurium. In addition, Koshima et al.13) emphasized that in facial reconstructive surgery, anastomosis of both peripheral nerves and the associated vasa nervorum can achieve earlier functional restoration. On the other hand, according to Koshima et al.14), when nerve defects are ≥5 cm, nerve reconstruction is clinically difficult and very often shows poor prognosis, but use of vascularized nerve flaps increases the rate of successful repair in all patients with nerve defects. A recent trend in reconstructive surgery has been to take the circulation of blood to nerves into consideration as much as possible14,15).

In the future, with developments in microsurgery, including advances in microvascular anastomosis techniques, the presence of the vasa nervorum and its clinical significance will become even more important. Morphological knowledge of the vasa nervorum will thus become increasingly important, especially in head and neck reconstructive and plastic surgery. We hope that future research will contribute to this knowledge.

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