Clinical Note

Study on the Carotid Artery Calcification Appearing on the Panoramic Radiography and Computed Tomography

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Abstract: The panoramic radiography taken for the dental treatment sometimes shows carotid artery calcification and it is known that the carotid artery calcification is associated with the onset of vascular disorder. In this regard, this study focused on the right/left difference in the carotid artery calcification showed by panoramic radiography and CT. The subjects of this study were 119 patients in the 5\(^{th}\) to the 10\(^{th}\) decade whose carotid artery calcification was confirmed by panoramic radiography and CT from August 2004 to June 2018 at Matsumoto Dental University Hospital. We investigated whether carotid artery calcification between the third and fourth cervical vertebrae can be detected using panoramic imaging. At the same time, the presence or absence of calcification image around the third and fourth cervical vertebrae was also investigated on the basis of axial CT image. The results indicated the following. As to the gender difference, the males demonstrated a slightly higher ratio of calcification in comparison with the females (10:9). As to the age distribution, a tendency of increase in calcification was noted in the 7\(^{th}\) decade and over and the ratio was the highest in the 8\(^{th}\) decade (42 cases). As to the right/left difference in the 119 patients, there were 67 patients with bilateral calcification and 52 patients with unilateral calcification (24 on the left side and 28 on the right side), indicating hardly any right/left difference. Regarding to the right/left prevalence, in the 7\(^{th}\) decade and over had bilateral calcification accounted for 50% and over. On the other hand, calcification was more frequently observed on the right side in the 6\(^{th}\) decade in the males as well as in the females. These results suggest that there is the different of unilateral (right/left difference) or bilateral carotid artery calcification by generation.

Key words: Carotid artery, Calcification, Panoramic radiography, CT

Introduction

Panoramic radiography can grasp whole teeth and the jaw, and soft tissue calcification in one radiographic image. This image method is indispensable in the dental treatment. According to investigation of the dental radiography conducted by Iwai et al.\(^1\), the annual quantity of panoramic radiographs taken in the target 59,059 institutions accounted for 12,336,000 indicating that many of the patients receiving the dental treatment are examined on the basis of panoramic radiography. Furthermore, in the 6\(^{th}\) decade accounted for the largest percentage as to the target age undergoing the panoramic radiography\(^1\), this age stratum is correlated to the arteriosclerosis risk factors (hypertension, heart disease, diabetes mellitus and hyperlipidemia). The panoramic radiography can detect carotid artery calcification\(^2\). The symptom observed is related to the onset of vascular disorder\(^2\). The area formed carotid artery calcification is almost at the carotid artery bifurcation between the third and fourth cervical vertebrae. That is likely to occur\(^2\), but the carotid artery calcification is found by chance in many cases because there is hardly any subjective symptom\(^3\). The panoramic radiographs taken for dental treatment can observe and diagnose the carotid artery calcification without subjective symptom. Therefore, we think that panoramic radiography to observe can be effective as the screening. However, even if calcified lesion is detected by panoramic radiography, it is difficult to discern the exact position, anatomical location of vessel, the calcification features in the vessel, etc. based on the radiographs\(^4\). Furthermore, many of the ectopic calcification images which is recognized in the soft tissue on the panoramic radiographic images are salivary calculi\(^5\). Other than that, hematoma, phlebolith, calcified lymph node near the region where carotid artery calcification formed, are also shown as calcification. These findings cause difficult the differential diagnosis. Thus, CT is required as careful examination.

Accordingly, we investigated the onset site of the carotid artery stenosis (carotid artery calcification) and the difference of the right/left in the patients who are taken for panoramic radiography and CT.

Materials and Methods

Subjects

The subjects of this study were 119 patients in the 5\(^{th}\) to the 10\(^{th}\) decade who received panoramic radiography and CT during the period from
August 2004 to June 2018 at Matsumoto Dental University Hospital. The carotid artery calcification was confirmed as followings: 63 males and 56 females; mean age 74.2 year-old; range between 45 and 95 year-old.

Imaging parameters
Panoramic imaging was performed using the Hyper-X (Asahiroentgen Industry Co., Ltd., Kyoto, Japan) with parameters of 64 kV and 8 mA. The activion 16 (Toshiba Medical Systems Co, Tochigi, Japan) with parameters of 120 kV, 60–200 mA and a rotation time of 0.75 second was used to acquire CT images. The axial images also were reconstructed with 2.0 mm slice thickness.

Assessment of panoramic radiographs and CT images
Using the panoramic radiographs of patients who underwent panoramic radiography between August 2004 and June 2018, whether or not calcification image is observed between the third and fourth cervical vertebrae was investigated. At the same time, the presence or absence of calcification image around the third and fourth cervical vertebrae was also investigated on the basis of axial CT image. Two dental radiologists (Experience: 6 years and 23 years) separately assessed the panoramic radiographs and CT images. When any difference occurred between these radiologists in the image evaluations, the diagnosis was made after discussion. This study was conducted under the approval of the Ethical Committee of the Matsumoto Dental University.

Results
Gender difference and age distribution of carotid artery calcification cases
The patients who have carotid artery calcification were 63 males and
The high level of the first cervical vertebra, with race difference. Not only that, the vascular diameter in the males is reportedly larger than that in the females\(^9\). The common carotid artery branches out with the subclavian artery on the right side of brachiocephalic artery. However, the common carotid artery on the left side directly branches out from the aortic arch. As the result of the left common carotid artery, it is longer than the right one by 4 to 5 cm. The fact suggested the right/left difference in calcification is attributable to these anatomical differences in common carotid arteries. There is also the right/left difference of the likelihood of arteriosclerosis onset in the subclavian artery that branches out of aortic arch, and it is reported that arteriosclerosis occurs mostly on the left\(^{10}\). The subclavian artery on the right side branches out of brachiocephalic artery. The latter artery is thick because it diverges into two vessels. Therefore it is hardly that arteriosclerosis occurs there. As a result, arteriosclerosis is also less likely to occur in the former that diverges from the latter. On the other hand, the left subclavian artery directly branches out of aortic arch. As a result, that artery is thinner in comparison with the brachiocephalic artery and therefore more susceptible to arteriosclerosis. Considering that the left and right carotid arteries demonstrate the same bifurcation as that observed in the subclavian arteries, it is assumed in this study that the calcification occurs more frequently on the left side. According to the result obtained this time, there is a tendency of bilateral calcification on the whole. However, when the cases were compared by age, the tendency of unilateral calcification was stronger in the 6th decade and younger while the tendency of bilateral calcification was stronger in the 7th decade and older. Furthermore, there was no gender difference as to the right/left difference in the prevalence. The probability of bilateral onset was high in the males and females.

It is considered that age-related unilateral (right/left difference) and bilateral differences exist in the carotid artery calcification. There is a tendency of bilateral onset in the elderly.

In other words, the higher the stenosis rate is, the more likely the onset of cerebral infarction occurs. Though the progression of arteriosclerosis is observed along with aging, there are individual differences in the symptom. It is reported that the progression of arteriosclerosis is influenced by the underlying diseases and life habits, and is associated with hypertension, diabetes mellitus, dyslipidemia, smoking, excessive drinking, etc. We plan to continue this research in the future by additionally investigating the life habits and history of diseases.

In conclusion, no significant difference between the left and right calcification was found in this study. As to the reason why, a significant difference could be found anatomically in the comparison with the bifurcation at the aortic arch but this type of investigation is not considered suitable for the anatomical study of the upper position of vessel. In near future date, we plan to investigate further by increasing the number of patients in the 6th decade and younger to elucidate the question of right/left difference.

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**Conflict of Interest**

The authors have declared that no COI existed.

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