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Research Article

Calcifications in Soft Tissues Observed in Panoramic Radiographs

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Abstract

Salivary disturbances, usually associated to calcifications occurring in the salivary gland ducts, alter the quality of life and well-being of the persons affected. The presence of saliva in adequate quantity and quality is of utmost importance for chewing, at the beginning of the digestion process. In addition, it is essential for swallowing, speech, and fixation of prosthetic devices. Glandular calcifications can also cause painful and uncomfortable instances. Dental Radiology has greatly contributed to the diagnosis of these alterations. With panoramic radiographs, important calcifications can be observed, such as: carotic atheroma; calcifications of the stylohyoid ligaments; calcifications of lymphatic nodules, tonsils, salivary glands, blood vessels, muscles, and other tissues. The purpose of this study was to carry out a retrospective study of the calcifications in soft tissues diagnosed with panoramic radiology. Prevalence was established depending on the location of the calcifications, through radiologic observation of patients from our database. These patients had been forwarded to the Unioeste Laboratory, so that the characteristics of each lesion could be related to its location, thus helping in the diagnosis. Data was acquired retrospectively analyzing panoramic radiographs from November 2014 to July 2016. The panoramic x-ray equipment used was the Rotograph Plus, with automatic processing of films performed by the Aconsermed 36A processor. Two thousand, four hundred and forty-four (2,444) radiographs were analyzed. Considering all calcifications, 132 individuals showed some level of calcification, representing 5.4% of the sample. Prevalence of sialoliths of the submandibular gland (49 patients) was found, followed by sialoliths of the parotid gland (40 patients), which did not differ significantly between each other ($p > 0.05$), although they differed from the other cases of calcifications ($p < 0.05$). This study aimed at encouraging the use panoramic radiography and demonstrating that it can be used to view such calcifications, and to classify them according to their location, thus preventing future and, at times, irreversible problems for patients.

Keywords: *Dental Radiology; Panoramic Radiographs; Salivary Disturbances; Calcifications; Retrospective Study*

Abbreviations

CT: Computed Tomography; CVA: Cerebrovascular Accident; MO: Myositis Ossificans; MOP: Myositis Ossificans Progressive; MOT: Myositis Ossificans Traumatic

Introduction

Deposition of calcium salts in the human skeleton occurs especially due to the accumulation of calcium phosphate. Since this is a biochemical phenomenon, normal deposition occurs in mineralized tissues. When it occurs in soft tissues, it does so in a disorganized fashion, the so-called heterotopic calcification, which can be divided into three types: 1) dystrophic calcification - that which is formed within degenerated tissue, i.e. in a pathological state; 2) idiopathic calcification - which results from the deposition of calcium in normal tissues, with normal calcium serologic rates; 3) metastatic calcification - which occurs by the precipitation of minerals inside normal tissues, with high calcium serologic rates [1]. Some authors point out that the reason why this abnormal deposition of calcium occurs is not yet clear [2].

The formation of a sialolith is called sialolithiasis, which is the result of the precipitation of calcium and phosphate salts around a niche of mucous or bacterial debris within a salivary gland or duct. Sialolithiasis is the most common disease of salivary glands in adults. Between 80 and 90% of salivary gland stones occur in submandibular glands. Cone Beam Computed Tomography (Cone Beam CT) is becoming a much requested examination to diagnose such calcifications, although a first examination is usually made through panoramic radiography [3]. The diagnosis of calcifications in soft tissues is commonly made in image examinations used in Dentistry. Findings in panoramic radiographs (4%) and Cone Beam CTs (35%) are common [4]. Salivary stasis may cause gland swellings and serve as a nutritious solution for bacteria, inflammation, and the gathering of pus. In approximately 1% of the patients that have such symptoms, the presence of sialoliths occurs [5].

Painful swelling, digitally-expressed and visual pus, tactile detection of calculi within the salivary glands are typically associated symptoms of sialoliths. A clinical supposition should lead to the search for a diagnosis based on images: ultrasonography and 2D-radiography are commonly used in such evaluations. Irregular findings sometimes justify Sialendoscopy, Sialography, Magnetic Resonance Imaging, and Computed Tomography [6]. The importance of a differential diagnosis among calcifications in soft tissues is based on different prognoses and treatments that they require [7,8].

Post-trauma musculature calcification is the so-called myositis ossificans traumatic (MOT). This condition can also present itself as progressive - also known as fibro-dysplasia ossificans progressive - which is an autosomal autoimmune disease that is not often described in the literature in muscles of mastication. The most common clinical symptom is the loss of mandibular mobility, i.e. trismus [9]. Myositis ossificans progressive (MOP) is associated to an overexpression of the gene coding the bone morphogenetic protein BMP4. In many cases, MOP occurs in childhood, and the movement of the joints gradually becomes more restricted, leading to ankylosis [10].

Myositis ossificans (MO) is a rare disease in which a reactive heterotopic bone deposition occurs in muscular tissues or other soft tissues [11]. It can manifest itself as a genetically-determined, progressive, systemic disease, involving multiple muscular groups or as a consequence of a trauma [10]. MO thus is divided broadly into myositis ossificans progressiva (MOP), and myositis ossificans traumatica (MOT). Myositis ossificans progressiva, also known as fibro-dysplasia ossificans progressiva, is an autosomal dominant disease in which multiple heterotopic ossifications develop in systemic muscles, fasciae, tendons, and ligaments. Radiographicallly, Shirkhoda., et al. [12] described four different phases of MOT: 1) The initial phase consists in capillary and mesenchymal cell proliferation in the periphery of the wound. Due to lack of calcification, this phase is inconspicuous on radiographic examination. (2) Initial phase of bone formation (1 - 2 weeks). (3) Intermediary phase (4 weeks). (4) Late phase (6 weeks). The mature phase appears as central radiolucency surrounded by a rim of bone. Surgical excision of a MOT is best performed during the mature phase of the lesion, when it is well-delineated from the surrounding skeletal muscles.

Thus, it is important to assess panoramic radiographs, in search of soft tissue calcifications, so as to diagnose their location in soft tissues and help define the treatment for these patients.

The differential diagnosis of carotid artery calcifications and other radiopacities in the region of the neck is essential. Among anatomic radiopacities, we may cite the hyoid bone, the epiglottis, triticeous cartilages, and ossifications of the stylohyoid and stylomandibular ligaments, visualized in panoramic and lateral cephalometric radiographs; stylohyoid process, visualized in panoramic radiographs; the superior horn of thyroid cartilage, visualized in lateral cephalometric radiographs. We can also find pathological radiopacities, such as calcified lymphatic nodules, sialoliths, phleboliths, tonsilloliths in panoramic radiographs and cephalometric laterals. Thyroid gland calcifications, which occasionally occur after therapeutic irradiation of the head are visualized in cephalometric images [13].

Tonsils are gatherings of lymphoid nodules that are in direct contact with the coating epithelium of the aerodigestive tract. They play an important role in immune responses since they are located in the course of aspirated or ingested antigens. Anatomically, they are located on the walls of the nasopharynx and oropharynx and have a stratified scaly epithelial coating, with occasional points of ciliated epithelium [14]. Phleboliths are idiopathic calcifications of blood clots (thrombosis). In the region of the head and neck, they are frequently associated to vascular lesions, which are classified into two clinical entities: hemangiomas and vascular malformations [15,16].

A cerebrovascular accident (CVA) is a neurological syndrome, which frequently occurs in adults, and is one of the greatest causes of morbidity and mortality worldwide. In western societies, it is the cause of 50% of all deaths, and occupies a prominent position amongst the elderly population [17]. Atheromas consist in point deposits of fat, a primary cholesterol, in the inner layer of arteries, and may prompt an inflammatory response, thus resulting in fibroblastic proliferation and incrustation of calcium salts, with various degrees of dystrophic calcification. The most frequently affected arteries are the aorta, the coronary arteries, and the cerebral arteries, including the carotid [18]. In 1981, it was observed that, through panoramic radiographs, it is possible to identify calcified atheroma plates at the bifurcation of the carotid artery, even in asymptomatic patients. To identify patients with hidden atheromas is of vital importance, since it should diminish the risk of their suffering a stroke [19]. Calcified atheromas of the carotid artery and their identification in panoramic radiographs have been studied as a factor that can predict cerebral vascular accidents [20,21].

Calcified triticeous cartilage is found centrally within the border of the lateral thyrohyoid ligaments. The function of the triticeous cartilage is unknown; however, it can help strengthen the thyrohyoid ligament. This cartilage is an uncommon radiographic finding, and it appears as an ovoid radiopaque image, some 2 to 4 mm wide, and 7 to 9 mm long, which is normally found within the space of air that exists alongside the larynx. Calcification of the triticeous cartilage may be mistaken for a carotid atheroma since their radiographic aspects are similar, although their causes are totally distinct and require different follow-ups [1].

The present paper consists in a retrospective study as to calcifications in soft tissues observed in panoramic radiographs, aiming at informing dental surgeons in their interpretations, and showing that it is possible to locate and classify such calcifications in panoramic radiographs, while treating patients as an indivisible whole.

Materials and Methods

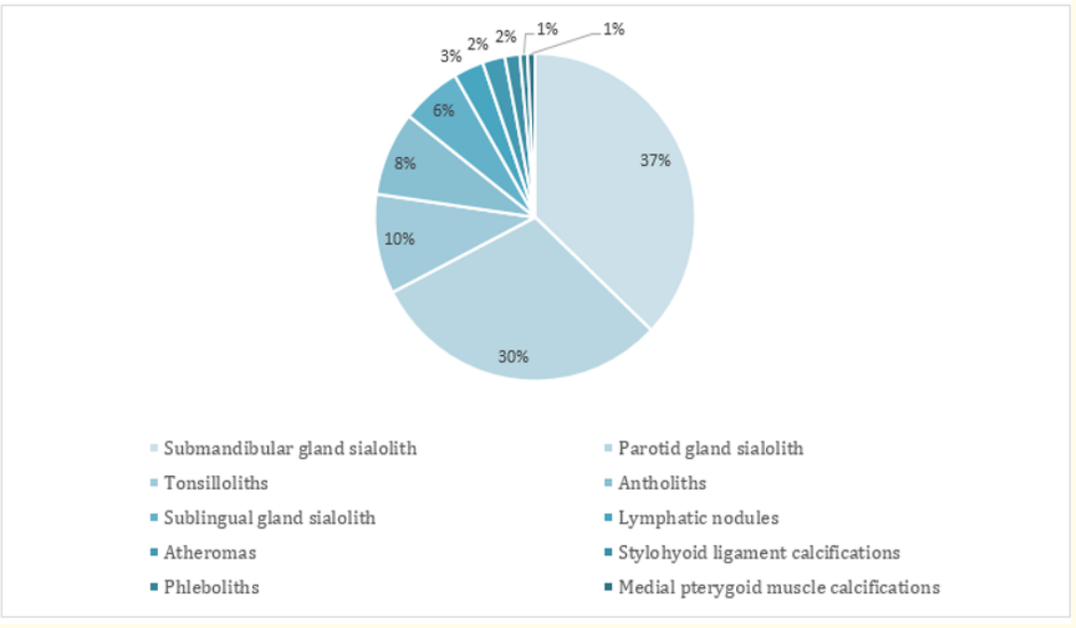
A retrospective study was carried out in which two thousand, four hundred and forty-four (2,444) radiographs, obtained within the period of November 2014 to November 2016, of patients forwarded to the Radiology Laboratory of the State University of the West of Paraná - UNIOESTE, were assessed. These radiographs were performed by panoramic x-ray equipment - the Rotograph Plus, Villa Sistemi, Italy - and automatic processing, by processor Aconsermed 36 A, Brazil. The analysis of the radiographs was made by an oral radiologist, in charge of the technical aspects of Unioeste laboratory and associate professor of the discipline of Radiology. For data collection and the assessment of panoramic radiographs, we used the panoramic radiographic scheme showing the typical geometry and location of selected calcifications and ossifications in soft tissues, as suggested by White., et al [1]. In two patients, owing to the size of the lesion, we chose to perform Computed Tomography Scans, for which we forwarded the patients to the University Hospital of the West of Paraná and to the clinic UNITOM (Cascavel Diagnostic Centre).

Two thousand, forty hundred and forty-four (2.444) panoramic radiographs, digitalized by a Canon Rebel 4ti camera, with 300 dpi in JPEG format, and visualized by means of iPhoto image visualization program, MacBook Pro, were observed. The inclusion criteria were patients directed to the laboratory of radiology of Unioeste with indication of panoramic x-ray of routine, of both sexes, in the age group between 18 and 65, in the period of November of 2014 to November of 2016. The exclusion criteria, however, were patients that didn't present calcification in soft tissues, observed in the panoramic x-rays.

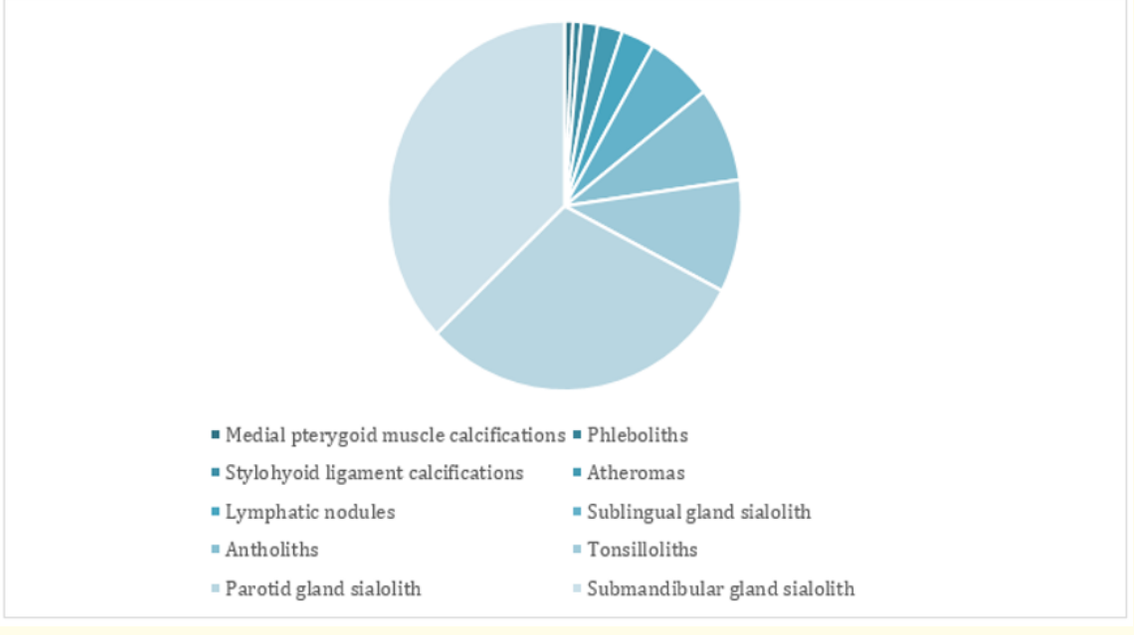
The sample had 132 individuals with calcifications in soft tissues, including 75 females and 57 males in an 18-to-65-year-old bracket. For the biostatistical analysis, we used the test Z of differences between two proportions.

Results and Discussion

Two thousand, four hundred and forty-four (2,444) radiographs from patients were assessed, and a total of one hundred and thirty-two (132) had some kind of calcification that was visualized in a panoramic radiography. The most common cases were of submandibular gland sialolith and parotid gland sialolith, which did not differ significantly one from the other ($p > 0.05$) but did so from the other cases ($p < 0.05$), which included tonsilloliths, anthroliths, sublingual gland sialolith, calcified lymphatic nodules, atheromas, stylohyoid ligament calcifications, phleboliths, and calcifications of the medial pterygoid muscle. The results obtained are shown in graphs 1 and 2.



Graph 1: *Percentage of calcifications in soft tissues.*



Graph 2: *Calcifications in soft tissues.*

In our study, as shown in the tables, we had the greatest number of calcifications observed in submandibular glands, followed by those in the parotid gland, and only one case of calcification in the medial pterygoid muscle. Calcifications in soft tissues are very common and may easily be found in routine panoramic radiographs and in computed tomography scans (CT scans). Some calcifications do not need treatment; however, others, depending on their location and size require interventions. Calcifications in salivary glands - sialoliths - occur owing to an electrolytic disturbance in salivary secretion, which total or partially obstructs the gland secretion duct, causing discomfort, pain and even prevents patients from eating. Temporomandibular disorder symptoms and facial pain, such as trigeminal neuralgia, as well as sore throats should lead to a radiography research of the elongated stylohyoid process and stylohyoid ligament. The existence of the Eagle syndrome should be investigated [22].

Sialolithiasis is a pathology that more often affects larger salivary glands, particularly submandibular glands (37.12% in our study), and are rare in smaller salivary glands. Despite the different types of diagnostic methods of sialoliths, a simple radiographic exam is generally able to detect calcified structures.

It may be observed that the incidence of nasopharyngeal tonsilloliths in the literature is 6.3% higher than the 0.1% reported in another study [23]. In our study, we found 13 patients with tonsilloliths (9.85%). This increase in incidence observed in the last decades may be attributed to the evolutional process of the radiographic techniques, with improvement of the technology used in addition to the advent of digital technology and CT scans.

In the literature, some 29 cases of MOT are reported in the head and neck region, with male over female predilection, and no established age relation. The clinical presentation of MOT in the region of the head and neck, especially when masticatory muscles are involved, is trismus. Mouth opening is limited, ranging from 1 cm to complete trismus. Rather than sudden, the limitation of the jaw movements is progressive, often with a history of blunt trauma involved. The muscle that is most commonly affected is the masseter, since it is most likely to receive a blow directly. The next group involved is the medial pterygoid muscle, followed by the lateral pterygoid and temporal muscles. Although the temporal muscle is just as vulnerable to traumas as the masseter, the probability of a MOT occurring in this group is lower, for some unknown reason. In a current case study, the patient complained of trismus associated to a history of trauma near the temporal muscle [24].

It is of utmost importance to know the exact cause of mouth opening limitation, or trismus, in patients that seek dental care. We observed the presence of one case only of calcification of the medial pterygoid muscle (0.76%) - MOT (myositis ossificans traumatica) of the muscles of mastication. CT scans and panoramic radiographs are essential diagnostic tools to assess conditions such as MO (Myositis ossificans) in the differential diagnosis of mouth opening limitation, and also to improve overall mouth opening and treatment results.

Calcified carotic artery atheromas and their identification in panoramic radiographs have been studied as a factor that may anticipate cerebral vascular accidents (CVAs). In our sample, we had 2.27% (3 individuals), which is highly significant in terms of preventing a cerebral vascular accident.

Phleboliths are almost always associated to hemangiomas. Therefore, the existence of a hemangioma can lead a professional to research the presence of such calcifications. Regarding numbers, phleboliths are multiple. They do not have a specific location. In our study, we had only one case of phleboliths observed in a panoramic radiography. It is important to point out that the radiographic findings of phleboliths in soft tissues in the region of the head and neck are evidence of the presence of vascular lesions [16].

Calcified carotid atheromas are, thus, hemodynamically significant lesions (i.e. those that cause luminal occlusion of over 50% of the vessel, with consequent increased risk of a stroke), and their prevalence has rarely been assessed [19,21].

A prevalence of sialolithiasis exists in approximately 1% of the population, gout being the only systemic disease that is known to cause salivary calculi/stones [25]. The initial presence of sialolithiasis is difficult to be diagnosed, since it is asymptomatic. A few examples are accidentally discovered in radiographs and only 20% of the cases are radiopaque [26-30].

Conclusion

Panoramic radiographs and tomographies routinely requested by dental surgeons can precociously portend the presence of calcifications in soft tissues, such as salivary glands, vessels, and muscles, and to the presence of carotic atheromas, which may help avoid or precociously treat serious arteriopathies, myositis and sialadenitis, in asymptomatic conditions. The knowledge of anatomy by dental surgeons affords early diagnoses through examinations of routine dental images, which emerge today together with the practice of holistic dentistry, wherein the mouth/body relation is seen as an indissoluble whole.

The routine use of the panoramic x-ray, as being an exam of preventive selection for calcifications in woven soft asymptomatic, it can minimize the damages caused by pathologies silent however serious, as it is the case of the atheromas in carotids, avoiding the occurrence of a cerebrovascular accident (CVA). Always reminding, that exam should be accomplished as selection method for subsequent accomplishments of more complex complemental exams.

Conflict of Interest

The authors declare they have no conflict of interest.

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