Contribution of Ultrasonography to the Diagnosis of Submucosal and Subcutaneous Nodular Lesions of the Oral and Maxillofacial Region: Analysis of Cases

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Abstract

Objective The aim of this study was to evaluate the contribution of ultrasonography in the establishment of the diagnosis of nonspecific nodular lesions of the oral soft tissues. We determined the indication of use and reliability of ultrasonography in the field of dentistry, considering whether it was of value in the conclusive diagnosis of these pathologies.

Materials and Methods We recruited 65 patients from the Oral Medicine Unit of São Lucas Hospital, who had submucosal and subcutaneous nodules, without established diagnosis. They were subjected to ultrasonography of the lesion, carried out with standardization of the protocol and equipment, utilizing a Doppler system. The ultrasonographic report was prepared by an experienced professional, noting the imaging characteristics as well as the possibility of diagnosis. Two calibrated examiners

analyzed the data, comparing the ultrasonographic report with the final diagnosis. Accordingly, we used established scoring, where zero corresponded to no contribution to the final diagnosis, 1 helped in the management of the case, and 2 when imaging determined the diagnosis.

Results A zero score was obtained for 12.3 % of the examinations performed, and 1 and 2 accounted for respectively 41.5 and 46.1 %, totaling a contribution of about 88 %. Ultrasonography was of value in the diagnosis of vascular lesions in 93.3 % and of neoplasms in 87.5 %. In the salivary gland diseases, it contributed to the final diagnosis in 75 %.

Conclusion The results demonstrated that ultrasonography is an effective tool in the determination of the definitive diagnosis of nonspecific nodular lesions of the soft tissues of the oral and maxillofacial region.

Keywords Ultrasonography · Nodular lesions · Oral pathology · Imaging diagnosis

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Introduction

Ultrasonography (US) was used more as a diagnostic tool by health care professionals in the 1970s, when a mapping of gray levels was introduced [1]. While it is widely used in the medical area, it is a resource that is rarely requested by the oral surgeon, who is often unaware of its indications, limitations and advantages [2]. Echography utilizes a nonionized form of radiation and is thus considered safe, where it can be repeated whenever necessary. It shows few artifacts, and it is of low cost in relation to similar methods and painless, being well tolerated by patients. This examination has the capacity to reproduce images in real time

and to provide millimetrical resolution and vascular information, if Doppler is utilized [3–6].

However, US of the head and neck region is considered one of the most complex examinations to be interpreted, requiring an experienced professional, who should have ample knowledge of the regional anatomy, be informed about the clinical condition of the patient and technically qualified to interpret abnormalities detected [4]. Since it is a dynamic test, the images obtained are better understood live. When archived and reproduced in planes, they can be difficult to interpret, especially if compared with computed tomography and magnetic resonance. It is believed that this is one of the reasons the makes echography an examination less requested than others that also utilizes sectioned imaging [5].

Nodular lesions that are located close to tissues of the face can mimic various pathologies. Inflammatory lesions, mucous retention phenomena, and benign and malignant neoplasms are examples of conditions that can develop in this anatomic region, often making a clinical diagnosis difficult [7]. Therefore, the aim of the present study was to evaluate the contribution of US in establishing the diagnosis of nonspecific nodular lesions of the oral and maxillofacial region, as well as making professionals in odontology aware of the indications and reliability of US.

Materials and Methods

We selected 65 patients with nonspecific nodular lesions localized in the oral and maxillofacial region, seen at the Oral Medicine Unit at the São Lucas Hospital (HSL) of the Pontifical Catholic University of Rio Grande do Sul (PUCRS), Brazil, during 18 months.

All patients included in the study had been indicated for US and were subjected to the examination, since it was not possible to establish a definitive diagnosis through clinical examination. US was performed in a diagnostic imaging center utilizing the same apparatus *Toshiba Japan—Aplio* with linear probe for examination of soft parts and frequencies of 7.5–12 MHz with a color Doppler system for high definition. US was carried out by a single examiner with ample experience in the interpretation of images of the oral and maxillofacial region (Figs. 1, 2).

The study was conducted after approval at the Committee of Ethics in Research of PUCRS. Patient information was collected and annotated from medical charts which contained data with regard to clinical characteristics of the lesion, descriptive US report and the final diagnosis, including the anatomopathological examination, whenever needed. All data obtained were kept confidential. The information was tabulated in spreadsheets developed

Fig. 1 Patient with nonspecific nodular lesion with 1 year of evolution (A). Operative image of the lesion (B). Surgical specimen (C). Photomicrograph where you can view mature fat cells and the diagnosis of setting Lipoma (D)

Fig. 2 Ultrasonography comparing the healthy side (A1) with the side of the lesion (A2). Sonographic image shows predominantly hypoechoic lesion, subcutaneous location and well-defined contours, suggesting Lipoma (B)

specifically for this study, which included the diagnosis from US and the final diagnosis. Accordingly, each lesion was stratified into scores on the basis of the following criteria:

- Score zero: when the diagnosis obtained with US differed from the final diagnosis
- Score 1: when the diagnosis obtained with US contributed to establishing the final diagnosis
- Score 2: when the diagnosis obtained with US defined the final diagnosis.

Later, 2 calibrated examiners performed the data analysis, comparing the US diagnosis with the final diagnosis (confirmed by histopathologic examination, if necessary), so that the scores could be defined.

The pathologies included in the statistical analysis were those that affected 10 or more individuals. The small number of cases for the others made it impossible to carry out mathematical calculations. On the basis of the data obtained, percentages were determined for the 3 scores of impact of US on the final diagnosis of the subcutaneous and submucosal nodular lesions of the oral and maxillo-facial region. After obtaining these results, a global *Fisher* exact test was performed to determine the *p* values that revealed if the method showed a statistically significant difference in the definition of the final diagnosis between the diseases detected in the study. Afterwards, for determination of *p* between all lesions, post hoc comparisons were carried out with *Finner–Bonferroni* correction, α being set at 5 %.

Results

Of the patients evaluated, 29 were males and 36 females, aged between 4 and 84 years. The individuals who had a histopathologic examination to determine the final diagnosis of the lesion, represented 66.1 % ($n = 43$) of the total. Of the 22 remaining patients, 33.8 % did not need a biopsy to confirm the definitive diagnosis, since the US

descriptive report determined how the patient would be treated (Table 1).

The zero score, which meant no contribution of echography in the establishment of the final diagnosis accounted for 12.3 % of the examinations performed. But the scores 1, indicating US helped in the management of the case, and 2, where it was possible to define the diagnosis through the image, represented respectively 41.5 and 46.1 %, totaling 87.6 % of cases where US was of value. This demonstrates that of the total of patients analyzed ($n = 65$), in 57 cases US contributed in a significant manner to the appropriate management of the patient (Table 2).

The diseases of the salivary glands (sialadenitis, sialolithiasis and mucus retention phenomena) represented 26.1 % ($n = 17$) of the alterations presented by the patients. The neoplastic lesions (malignant and benign) corresponded to 24.6 % ($n = 16$) and the vascular, blood and lymphatic, were diagnosed in 23.1 % ($n = 15$) of the individuals. The inflammatory reaction processes made up 21.5 % ($n = 14$) of the cases evaluated. The cystic lesions and lymph retention phenomena accounted for only 3.1 % ($n = 2$) and 1.5 % ($n = 1$), respectively (Table 3).

According to the scores determined by the examiners (Table 4), the method contributed to the diagnosis of the vascular lesions in 93.3 %. In the neoplasms, ultrasonography was useful in the management of the lesions, the malignant as well as the benign ones, in 87.5 %. With regard to mucus retention phenomena, US had a role in the establishment of the final diagnosis in 76.5 %. The other alterations described were represented by limited numbers

Table 1 Distribution of patients with nonspecific submucosal or subcutaneous nodules who underwent surgery and histological examination, and those who did not require biopsy of lesions

Patients	Total	%
Contained pathologic evaluation	43	66.1
Contained no pathologic evaluation	22	33.8
	65	99.9

of patients, making effective analysis of these data impossible.

The rates of the contribution of US were not the same for the different types of lesions ($p = 0.0017$). It was possible to see that in the pathologies of vascular nature, US demonstrated a statistically greater contribution than in the others. This means that the vascular lesions, when compared with salivary gland diseases, inflammatory reaction processes and neoplasms, showed a statistically significant difference ($p = 0.024$, $p = 0.009$, $p = 0.06$). However, the study did not have appropriate conditions to differentiate the others, despite the nominal values of the neoplasms being less than that of the others, because comparisons of the diagnostic method did not show statistically significant differences.

US was able to determine the contents of the lesions in 80 % of the examinations. It indicated the vascular nature of the nodules in 23.1 %, the presence of thick fluid or mucus in the vicinity of the lesion in 21.5 % and if the nodule was solid in 35.4 %. However, some

ultrasonographic reports were not considered clear in relation to the contents of the lesions.

Discussion

High frequency US is a diagnostic tool that is noninvasive, low cost and painless, which is commonly utilized in the medical area, where it is particularly indicated in the examination of soft tissues. However, it is not usually utilized for diagnostic investigation of intraoral lesions [6]. In this study, we evaluated the contribution of US as an auxiliary method in the diagnosis of submucosal or subcutaneous nodular lesions in the soft tissues of the oral and maxillofacial region.

This study did not consider the obligation of performing an anatomopathologic examination as the gold standard in all cases, because in some lesions, especially vascular, ultrasonographic diagnosis was considered definitive for the treatment of the patients. The histopathologic diagnosis was established only in the lesions with surgical indication.

Studies evaluating the use of US have been conducted in different lesions in the facial soft tissues, and despite extremely satisfactory results, they did not emphasize its minimal utilization as a diagnostic method by oral surgeons. This is probably due to an academic gap, lacking due training of the professionals in the use and interpretation of this resource [2].

The result obtained for the extent of the contribution that US showed as a diagnostic tool, in all patients, was 87.6 %. In the diseases of possible inflammatory cause, we demonstrated that US was effective in 92.8 %. This percentage is in contrast to that obtained by various authors who analyzed nonspecific swelling in orofacial soft tissues. They evaluated lesions of probable inflammatory nature and found a sensitivity of 96 %, that is, the fraction of the patients who showed a positive response in the ultrasonographic examination among those individuals who had the disease [8–12]. On the contrary, Douglas et al. [13] found a 65 % sensitivity for the examination. Along this same line of research, Pallagatti et al. [14] and Nisha et al. [12]

Table 2 Distribution of scores set by the examiners, as well as the percentage that each of them represented in aid of determining the final diagnosis of patients

Score	Total (n = 65)	%
Zero	8	12.3
1	27	41.5
2	30	46.1

Table 3 Classification, absolute and percentage distribution of subcutaneous and submucosal nodular lesions

Lesions	Total (n = 65)	%
Vascular lesions	15	23.1
Neoplasms	16	24.6
Salivary gland diseases	17	26.1
Inflammatory processes reaction	14	21.5
Cystic lesions	2	3.1
Retention lymph	1	1.5

Table 4 Distribution of lesions diagnosed in related score contribution of ultrasonography study to establish the final diagnosis

Lesions	US differed from final	US contributed to final	US defined to final
Vascular lesions	6.7 % (n = 1)	6.7 % (n = 1)	86.7 % (n = 13)
Neoplasms	12.5 % (n = 2)	62.5 % (n = 10)	25 % (n = 4)
Inflammatory processes reaction	7.1 % (n = 1)	64.3 % (n = 9)	28.6 % (n = 4)
Salivary gland diseases	23.5 % (n = 4)	35.3 % (n = 6)	41.2 % (n = 7)
Cystic lesions	Zero	50 % (n = 1)	50 % (n = 1)
Retention lymph	Zero	Zero	100 % (n = 1)

respectively determined an accuracy of 88.9 and 97.1 % for US.

According to some authors, US is a complementary examination that helps confirm the diagnosis of abscesses and delineate their anatomic location, differentiating them from cellulitis [11, 15], and thereby demonstrating the presence of fluids or abscesses in the superficial spaces of the face [3] distinguishing the stage of the infection [16].

Among the vascular alterations, the hemangiomas were the most prevalent, representing 23.1 % of the lesions studied. The result obtained in this study is similar to that of Ntomouchtsis et al. [17] who studied benign lesions in the lips of 420 patients. The authors found that the hemangiomas were the most common, corresponding to 19.3 %. When these lesions are present on the tissue surface, the clinical diagnosis can be favored, especially through a semitechnical procedure called diascopy. However, in deeper lesions, that is, located in the submucosa of the orofacial soft tissues, sufficient information generally cannot be obtained from a clinical diagnosis to determine the vascular origin of the pathology evaluated. For this, we must introduce available imaging resources, including echography. Vascular alterations of the lesions visualized

by US using the Doppler system were determinant and defined the management of the patient. This means that in 13 (86.7 %) of the 15 vascular alterations present in the study, US defined the final diagnosis. The use of the Doppler system was essential for evaluation of the diseases of vascular origin, since it determines the origin of the flow in the lesion (arterial or venous), as well as its velocity (cm/s). The examination allows a direct visualization of this alteration in real time, without the need of intravenous contrast agents [18, 19].

Salivary gland diseases encompass a wide range of pathologies. Various authors have described imaging methods that can help in making the final diagnosis. A near unanimity of authors consider US the first choice among all available imaging resources in the detection of diseases of the salivary glands [5, 7, 20–26]. However, the majority of the scholars only refer to its indications, advantages and disadvantages in relation to other imaging examinations. In the present study, the extent that US contributed, determined by summing the scores of definition and aid in the management of the patient, was 76.5 % of the total cases.

Of the 16 cases of neoplasms, US helped in the management of the patient in 87.5 % of cases. The malignant

Fig. 3 Increase of nonspecific mass in the left buccal mucosa, with 2 months of evolution (A). Ultrasonography of the region that shows predominantly hypoechoic, homogeneous, submucosal location

(B) nodule. Appearance during the surgery (C). Operative piece that histopathological diagnosis was adenocarcinoma (D)

and benign lesions were grouped together, since according to Zengel et al. [27] tumors smaller than 2 cm in diameter usually have a homogeneous structure and show defined borders and can be consequently diagnosed mistakenly as benign lesions (Fig. 3). Gritzmam [20] analyzed 302 patients and found a sensitivity of 100 % for the examination in the identification of neoplasms. The results of the study were in accordance with those reported by Millesi et al. [28] and Hodder et al. [29], who found values over 90 %. Other authors obtained different results; Haberal et al. [30] and Anand et al. [31] found rates over 70 %, but Hohlweg-Majert et al. [32] described a sensitivity of 24.5 % for US.

In bone tissue, according to Millesi et al. [28], US is capable of evaluating the tissue destruction caused by malignant lesions in the oral and maxillofacial region, with the exception of the lingual side of the mandibular ramus. Compared with other techniques, US can be considered of great value, with a high contribution in particular regions. Ng et al. [33] described a case of mandibular osteosarcoma evaluated by US and concluded that the use of this resource was essential for the visualization of signs of malignancy. They considered echography a useful modality for investigating the early stages of these pathologies. McCann et al. [34] also mentioned US as an effective tool in the initial analysis of fractures of the orbital–zygomatic complex, thereby reducing the number of X-rays required for the patients. It is known that although echography can be used in the analysis of bony structures, some authors believe that its use is not recommended for diagnosing temporomandibular disorders in a conclusive manner [35].

Some limitations that occurred during the course of the present study should be mentioned. A limited number of patients made up of some groups of analyzed lesions, making it difficult to make comparisons between the groups of nodular lesions and also with other studies previously conducted in this area. However, it was our purpose to bring together a larger number of patients with nonspecific swelling, where the clinical diagnosis represented similar conditions. For this reason, the neoplasms, malignant and benign, including those originating from the salivary glands, as well as metastatic lymph nodes, were grouped together. But in the diseases associated with the salivary glands, they were put in the group exclusively for sialadenitis, sialolithiasis and Sjögren's syndrome.

In the literature, there are still few studies that have evaluated the use of US in investigating nodular lesions in nonspecific clinical diagnosis and have indicated it for professionals in dentistry. In contrast, in the medical area, it is widely used in the most diverse specialties. Currently, more studies are being conducted on the use of US for evaluation of intraoral lesions and structures, due to the emergence of new technologies, such as the use of higher

frequencies and smaller transducers, making it possible to introduce them inside the oral cavity.

The results obtained in this study demonstrated that US supplies quality information during the investigation process and diagnosis, contributing to the management of the submucosal or subcutaneous nodular lesions. This is a recurring clinical situation in dental practice, and through this examination, the oral surgeon is more able to rapidly and adequately manage the patient. Thus, this resource can be indicated as a viable method in the routine evaluation of the nonspecific swelling of the soft tissues in the oral-maxillofacial region, since it is well tolerated by the patient, has low cost and does not expose to ionizing radiation.

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