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## The Role of Elastasonography in the Differentiation of Parotid Gland Lesions: Report of Three Cases and Review of the Literature

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**Background:**

The parotid gland is the mostly affected site among major salivary gland tumors in up to 85% of cases. Preoperative knowledge of the tumour nature is crucial since it influences the surgical procedure and patient's morbidity, especially the risk of facial nerve palsy. Ultrasonography is commonly used as the first line imaging modality for the salivary gland lesions. A pitfall is that the histologic pleomorphism often reflects an imaging pleomorphism.

**Case Report:**

Herein we aimed to present the role of elastasonography in three parotid lesions: a case of benign pleomorphic adenoma, a Warthin's tumour and a malignant parotid tumour.

**Conclusions:**

Our findings show that malignant parotid lesion was the stiffest lesion according to elastasonography. Warthin's tumour demonstrated soft elastasonographic features. The pleomorphic adenoma was also interpreted as stiff by elastasonography suggesting that the elastasonographic features of pleomorphic adenoma may resemble those of malignant lesions limiting the utility of the technique.

**MeSH Keywords:**

Elasticity Imaging Techniques • Parotid Neoplasms • Ultrasonography

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<http://www.polradiol.com/abstract/index/idArt/891019>

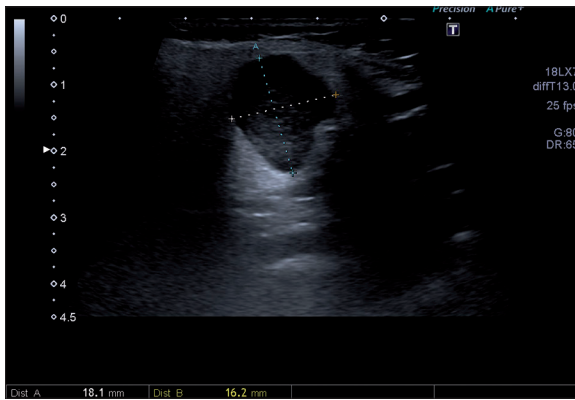
### Background

Salivary gland neoplasms are uncommon, with an incidence of 1–5 cases per 100,000 people per year and constitute 2–6% of the neoplasms of the head and neck region [1,2]. The parotid gland is the mostly affected major salivary gland in up to 85% of cases. Pleomorphic adenomas are the most common neoplasms of the parotid gland which are benign but may infrequently recur and show malignant transformation [3]. The surgical methods are chosen according to the characteristics of the lesion. An apparently benign lesion is excised by a less invasive technique such as extracapsular dissection, whereas total or radical parotidectomy combined with neck dissection is required if there is a suspicion of malignancy [4,5]. Therefore, preoperative knowledge of the tumour nature is crucial since it influences the surgical procedure and patient's morbidity, especially the risk of facial nerve palsy [6–9].

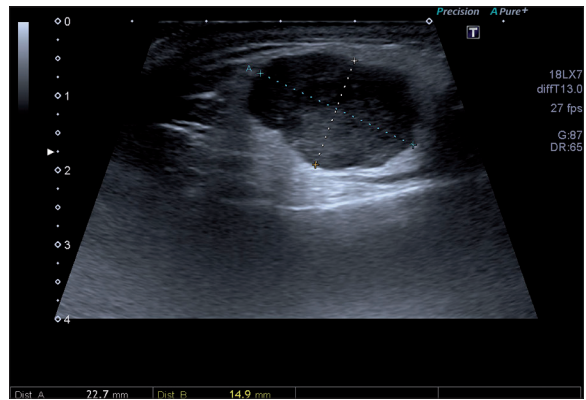
Herein we aimed to present the role of elastasonography in three parotid gland lesions: a case of benign pleomorphic adenoma, Warthin's tumour and malignant parotid tumour.

### Case Report

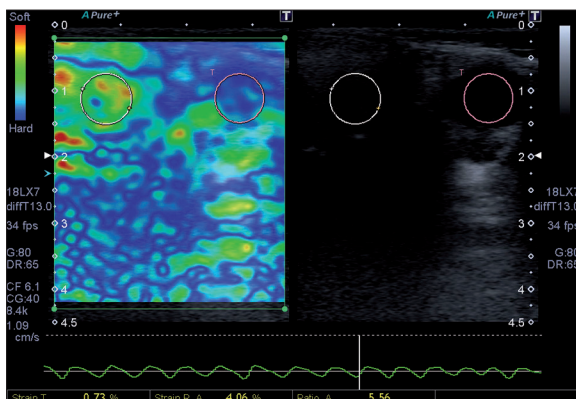
All patients were examined by conventional ultrasonography (US) and elastasonography (using a linear transducer of 8–13 MHz Toshiba Aplio 500, Tokyo, Japan). For the elastasonographic examination an intermittent light pressure was applied until the pressure was standardized until a sinusoid was formed between two predetermined lines to maintain the pressure at the optimal level. Sonograms and elastograms were displayed next to each other. The lesion and surrounding subcutaneous fat tissue were evaluated. An elastogram based on a color scale was displayed on the B-mode image which ranges from color red to blue. The red color represented tissue with greatest elasticity meaning



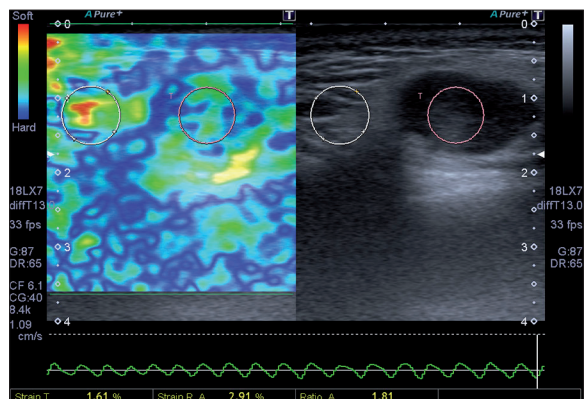
**Figure 1.** Ultrasonography demonstrated a hypoechoic solid mass with lobulated contours and homogeneous internal structure located in the right superficial parotid gland of a 28-year-old female patient.



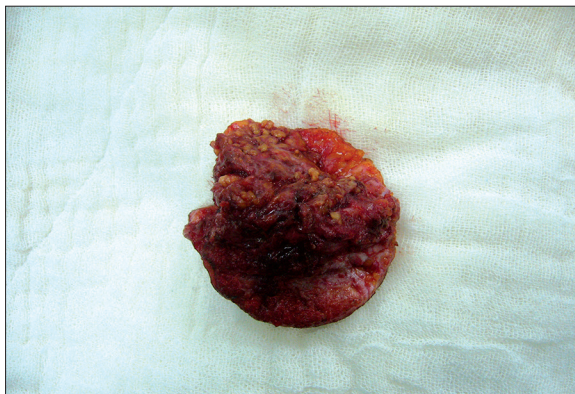
**Figure 4.** Ultrasonography demonstrated a hypoechoic solid mass with minimally lobulated contours and homogeneous internal structure located in the left superficial parotid gland of a 35-year-old female patient.



**Figure 2.** The elastosonographic examination of the same lesion revealed predominantly blue color and a strain ratio of 5.56.



**Figure 5.** The elastosonographic examination of the same lesion revealed predominantly green color and a strain ratio of 1.81.



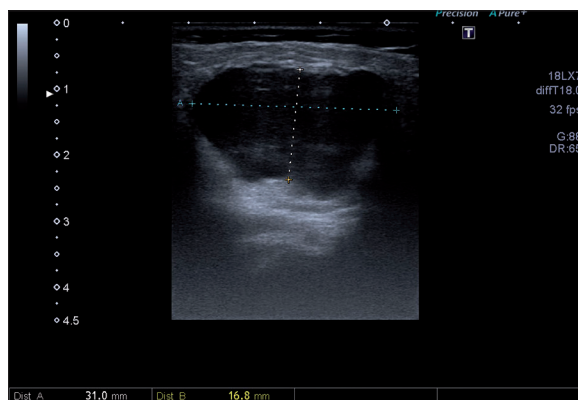
**Figure 3.** The lesion excised with superficial parotidectomy was indicative of pleomorphic adenoma.



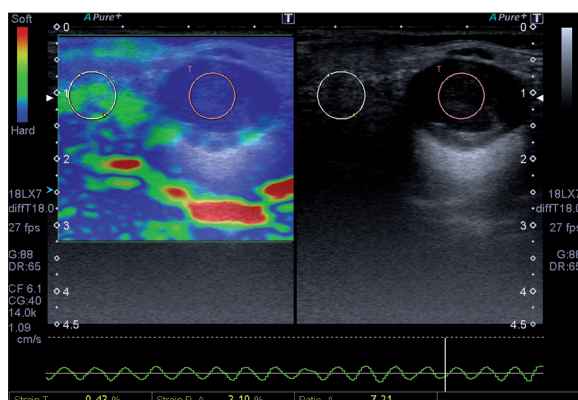
**Figure 6.** The lesion was excised with superficial parotidectomy and the pathology result was indicative of Wharthin's tumour.

softest components, whereas the blue color represented tissue with no strain meaning hardest components. A region-of-interest (ROI) box with an adjustable size covering the majority of the target lesion was placed (average strain represented as "strain T") taking the adjacent subcutaneous fat tissue preferably with the same depth and the same size as the reference (average strain represented as "strain R A"). Strain ratio (strain R A/ strain T) which reflects the stiffness of the lesion was calculated for each lesion.

Our first case was a 28-year-old female patient with a painless swelling in the right preauricular region. US revealed a hypoechoic solid mass with lobulated contours and homogeneous internal structure located in the right superficial parotid gland. It measured 18.1×16.2 mm (Figure 1). The lesion presented potential benign sonographic features. The elastosonographic examination revealed predominantly blue color and a strain ratio of 5.56 which was interpreted as stiff (Figure 2). The lesion was excised with superficial parotidectomy (Figure 3)



**Figure 7.** Ultrasonography demonstrated an irregular hypoechoic solid mass with indistinct posterior margins and homogeneous internal structure located in the left parotid gland of a 72-year-old female patient.



**Figure 8.** The elastasonographic examination of the same lesion revealed blue color and a strain ratio of 7.21.



**Figure 9.** The lesion was excised with left total parotidectomy and modified neck dissection. The pathology result was indicative of primary squamous cell cancer of the parotid gland.

and the pathology result was indicative of pleomorphic adenoma.

Our second case was a 35-year-old female patient with a painless swelling in the left preauricular region. US revealed a hypoechoic solid mass with minimally lobulated contours and homogeneous internal structure located in the left superficial parotid gland. It measured

22.7×14.9 mm (Figure 4). The lesion presented potential benign sonographic features. The elastasonographic examination revealed predominantly green color and a strain ratio of 1.81 which was interpreted as soft (Figure 5). The lesion was excised with superficial parotidectomy (Figure 6) and the pathology result was indicative of Warthin's tumour.

Our third case was a 72-year-old female patient with a painful swelling in the left preauricular region. US revealed an irregular hypoechoic solid mass with indistinct posterior margins and homogeneous internal structure located in the left parotid gland. It measured 31×16.8 mm (Figure 7). The lesion presented sonographic features indicative of malignancy. The elastasonographic examination revealed blue color and a strain ratio of 7.21 which was interpreted as stiff (Figure 8). The lesion was excised with left total parotidectomy and modified neck dissection (Figure 9). The pathology result was typical for primary squamous cell cancer of the parotid gland due to the absence of any other primary foci in the systemic evaluation. The tumour showed lymphovascular and perineural invasion. The diameter of the largest metastatic lymph node was 8 mm and there was no extranodal invasion.

## Discussion

US is commonly used as the first-line imaging modality for salivary gland lesions. It gives information about the exact location and size of tumours [10]. Although B-mode and Doppler US show features suggestive of a specific diagnosis, there is considerable overlap between imaging features of benign and low-grade malignant neoplasms. Preoperative fine needle aspiration cytology may improve the diagnostic accuracy, although false-negative and false-positive results are possible even with US guidance [11,12]. Some interest has recently been focused on elastasonography, with the question of whether it might be an aid to the differential diagnosis of benign and malignant salivary gland lesions. The technique has recently gained attention for the lesions of the head and neck region [13–16]. Little is known about the value of elastasonography in the evaluation of parotid gland tumours.

Our findings show that malignant parotid lesion was the stiffest lesion according to elastasonography. The pleomorphic adenoma was also interpreted as stiff with elastasonography indicating that the elastasonographic features of pleomorphic adenoma may resemble those of malignant lesions which limits the utility of the technique. On the other hand, Warthin's tumour demonstrated soft elastasonographic features.

Literature review showed that, in an attempt to identify a typical sonoelastographic pattern for pleomorphic adenomas, Dumitriu et al. examined 70 salivary gland masses. The elastographic aspect was heterogeneous for most tumours, but the elastic composition identified in most pleomorphic adenomas was also present in a significant proportion of malignant tumours. Therefore, a typical sonoelastographic pattern for pleomorphic adenomas could not be demonstrated. The most specific finding was the presence of a lobulated contour, which was not seen in any other



benign lesion, but seldomly in some malignant lesions [17]. In another study with 74 salivary gland masses Dumitriu et al. showed that the difference in elastographic score was statistically significant between benign and malignant tumours, but the difference between pleomorphic adenomas and malignant tumours and that between pleomorphic adenomas and Warthin's tumours were not statistically significant, limiting its use [18].

Bhatia et al. conducted a study with qualitative ultrasound elastography on 65 parotid or submandibular gland masses. Authors concluded that the technique had a poor ability to discriminate benign lesions from malignant lesions. Particularly the differentiation of pleomorphic adenomas presented a problem since they were firmer than Warthin's tumours [19]. In a subsequent study with shear wave elastography on 55 benign and 5 malignant parotid or submandibular gland lesions, Bhatia et al. indicated that elastographic indices of the salivary gland tumours differ according to the pathology and that pleomorphic adenomas were stiffer than Warthin's tumours. However, authors emphasized that overlapping indices for benign and malignant tumours limit their potential role [20].

Klintworth et al. investigated B-mode and elastographical US criteria to differentiate between benign and malignant parotid tumours and to define characteristic elastographical patterns for pleomorphic adenomas and Warthin's

tumours [21]. In the analysis of 57 patients with parotid gland tumours with a combination of B-mode and elastographic US, authors stated that different elastosonographic patterns were observed for particular histological subtypes of parotid gland tumours. Authors concluded that elastosonography can therefore improve the diagnostic performance of US alone and it can help in differentiation of benign from malignant parotid tumours. Authors indicated that the elastographical "garland sign", a reticular distribution of stiff tissue within the whole tumour, was seen more frequently in malignant parotid tumours. Pleomorphic adenomas showed an elastographical "dense core sign", a central zone of very stiff tissue with softer tissue in the vicinity. Warthin's tumours showed an elastographical "half-half sign", with a stiff area located in the superficial half of a lesion while the deeper part had a softer appearance. Parotid cysts showed an elastographical "bull's eye sign", a very soft, ellipsoid area in the centre of a lesion.

## Conclusions

In the literature the majority of studies have concluded that there is considerable overlap between benign and malignant lesions making the integration of elastosonography into routine clinical practice questionable [17–21]. Further studies with a higher number of salivary gland lesions are required to validate the results. Still, the pitfall is that the histologic pleomorphism often reflects the imaging pleomorphism.

## References:

- Pinkston JA, Cole P: Incidence rates of salivary gland tumors: results from a population-based study. *Otolaryngol Head Neck Surg*, 1999; 120: 834–40
- Spiro RH: Salivary neoplasms: overview of a 35-year experience with 2,807 patients. *Head Neck Surg*, 1986; 8: 177–84
- Lee YYP, Wong KT, King AD et al: Imaging of salivary gland tumors. *Eur J Radiol*, 2008; 66: 419–36
- Klintworth N, Zenk J, Koch M et al: Postoperative complications after extracapsular dissection of benign parotid lesions with particular reference to facial nerve function. *Laryngoscope*, 2010; 120: 484–90
- Stennert E, Wittekindt C, Klusmann JP et al: New aspects in parotid gland surgery. *Otolaryngol Pol*, 2004; 58: 109–14
- Koch M, Zenk J, Iro H: Long-term results of morbidity after parotid gland surgery in benign disease. *Laryngoscope*, 2010; 120: 724–30
- Gritzmann N, Rettenbacher T, Hollerweger A et al: Sonography of the salivary glands. *Eur Radiol*, 2003; 13: 964–75
- Wakasugi-Sato N, Kodama M, Matsuo K et al: Advanced clinical usefulness of ultrasonography for diseases in oral and maxillofacial regions. *Int J Dent*, 2010; 2010: 639382
- Burke CJ, Thomas RH, Howlett D: Imaging the major salivary glands. *Br J Oral Maxillofac Surg*, 2011; 49: 261–69
- Zhang L, Zhang ZY: Evaluation of the ultrasonographic features of salivary gland tumours. *Chin J Dent Res*, 2010; 13: 133–37
- Zbaren P, Guelat D, Loosli H, Stauffer E: Parotid tumors: fine-needle aspiration and/or frozen section. *Otolaryngol Head Neck Surg*, 2008; 139: 811–15
- Howlett DC, Mercer J, Williams MD: Same day diagnosis of neck lumps using ultrasound-guided fine-needle core biopsy. *Br J Oral Maxillofac Surg*, 2008; 46: 64–65
- Kurt A, Gunes Tatar I, Ipek A et al: B-Mode and Elastosonographic Evaluation to Determine the Reference Elastosonography Values for Cervical Lymph Nodes. *ISRN Radiology* vol. 2013, Article ID 895287
- Tatar IG, Kurt A, Hekimoglu B: Ultrasound Elastography: A new era for vulnerable carotid plaque imaging? *Journal-CVS*, 2013; 1: 20–24
- Gunes Tatar I, Kurt A, Yilmaz KB et al: The learning curve of real time elastosonography: a preliminary study conducted for the assessment of malignancy risk in thyroid nodules. *Med Ultrason*, 2013; 15: 278–84
- Gunes Tatar I, Kurt A, Yilmaz KB et al: The role of elastosonography, gray-scale and colour flow Doppler sonography in prediction of malignancy in thyroid nodules. *Radiol Oncol*, 2014
- Dumitriu D, Dudea SM, Botar-Jid C et al: Ultrasonographic and sonoelastographic features of pleomorphic adenomas of the salivary glands. *Med Ultrason*, 2010; 12(3): 175–83
- Dumitriu D, Dudea S, Botar-Jid C et al: Real-time sonoelastography of major salivary gland tumours. *Am J Roentgenol*, 2011, 197: 924–30
- Bhatia KS, Rasalkar DD, Lee YP et al: Evaluation of realtime qualitative sonoelastography of focal lesions in the parotid and submandibular glands: applications and limitations. *Eur Radiol*, 2010; 20(8): 1958–64
- Bhatia KS, Cho CC, Tong CS et al: Shear wave elastography of focal salivary gland lesions: preliminary experience in a routine head and neck US clinic. *Eur Radiol*, 2012; 22(5): 957–65
- Klintworth N, Mantsopoulos K, Zenk J et al: Sonoelastography of parotid gland tumours: initial experience and identification of characteristic patterns. *Eur Radiol*, 2012, 22: 947–56