INTRODUCTION

Conservation and functional maintenance of the facial nerve are principles of surgery for benign parotid tumors. Since the difficulty and incidence of complications differ between surgeries for superficial and deep tumors, it is very important to understand the facial nerve distribution in the parotid gland, i.e., the positional relationship between the nerve and tumor, in preoperative evaluation.

In this study, using Ultrasonography (US), we attempted to differentiate superficial and deep tumors. We clarified the US characteristics of parotid tumors by location based on the preoperative US and surgical findings. In addition, US diagnostic criteria for the preoperative differentiation of superficial and deep tumors were prepared.

METHODS AND MATERIALS

154 patients with benign parotid tumors who underwent preoperative US and MRI and then surgery between 2003 and 2010 at the Department of Otolaryngology, Head and Neck Surgery, Osaka Medical College. The histologic type: pleomorphic adenoma in 85, Warthin’s tumor in 64, basal cell adenoma in 2, hemangioma in 1, schwannoma in 1, and a cyst in 1.

The mean age was 53.9 years (12-85 years).

Study design: retrospective study

For US, Apio XV (7.5 MHz mode) of TOSHIBA was used.

The significance of differences was analyzed employing the Mann-Whitney U test, regarding p<0.05 as significant.

RESULTS

The MFTD was 7.9 mm in superficial, deep, and inferior pole tumors (p<0.001). The sensitivity, specificity, and accuracy of an MFTD ≥ 3 mm for the differentiation of deep tumors were 76, 87, and 84%.

Conclusion:

A tumor with an MFTD ≥ 3 mm on preoperative US is very likely to be a deep tumor based on a new differentiation method for deep parotid tumors considering those present at other locations.

Figure 1. Minimum fascia-tumor distance (MFTD).

The minimum thickness of the normal parotid gland tissue between the parotideomasseteric fascia and tumor was measured before surgery using ultrasonography (dotted cross symbol: MFTD. NPG: normal parotid gland).

(A) Ultrasonography for superficial tumor whose MFTD was 0.6 mm.

(B) MRI for superficial tumor.

(C) Ultrasonography for deep tumor whose MFTD was 4.3 mm.

(D) MRI for deep tumor.

Figure 2. Classification by localization of the parotid tumor

Tumors were classified into superficial, deep, and inferior pole tumors based on the surgical findings. Tumors located at sites shallower and deeper than the facial nerve were defined as superficial and deep tumors, respectively. Tumors located inferior to the marginal mandibular branch of the facial nerve are different from deep tumors with regard to the surgical procedure and postoperative complications, despite being present at deep sites. Therefore, tumors with their center located inferior to the marginal mandibular branch were defined as inferior pole tumors.

Figure 3. The MFTD of parotid tumors by location

The maximum tumor diameters were 25.3 ± 8.5, 27.4 ± 8.2, and 26.0 ± 7.9 mm in superficial, deep, and inferior pole tumors, respectively, showing no significant difference among the groups. The MFTD was 1.4 ± 1.0, 4.8 ± 1.3, and 2.0 ± 1.3 mm, respectively, showing significant differences between superficial and deep tumors and between inferior pole and deep tumors (p<0.001), but no significant difference was noted between superficial and inferior pole tumors.

Regarding the association between the maximum tumor diameter and MFTD, a weak positive correlation was noted in superficial tumors (r=0.29, p=0.02), but no correlation was noted in deep (r=0.09, p=0.86) or inferior pole (r=0.14, p=0.29) tumors.

Figure 4. Cut-off value of the MFTD for the differentiation of deep tumors

An ROC curve was prepared by plotting the MFTD against deep tumors involving 92 patients with superficial tumors. The highest diagnostic efficiency was observed at an MFTD of 3 mm. When tumors with an MFTD ≥ 3 mm were regarded as deep tumors, the sensitivity, specificity, and accuracy were 85 (23/27), 91 (59/65), and 89% (82/92), respectively.

Figure 5. Location in the parotid gland and the MFTD of deep tumors

Anteroposterior distribution and MFTD values of deep tumors. In the 27 deep tumor cases, the distance between the line connecting the apexes of the pointer cartilage and mastoid process and tumor center (Y) was inversely correlated with the MFTD (X). In all 4 cases with an MFTD <3 mm, the distance was 20 mm or greater.

Figure 6. Identification of the facial nerve by ultrasonography

Identification of the facial nerve by ultrasonography is also difficult, we attempted to differentiate superficial and deep tumors by paying attention to the MFTD. The normal parotid gland tissue in the shallow layer of deep tumors is thicker than that in the shallow layer of superficial tumors, which may increase the MFTD of deep tumors (ie, the MFTD of deep tumors was significantly greater than that of superficial and inferior pole tumors). Thus, we investigated the optimum cutoff value of the MFTD to diagnose deep tumors. On analysis using an ROC curve, when an MFTD 3 mm was set as the cutoff value of the deep tumor type, the sensitivity, specificity, and accuracy were 85%, 91%, and 89%, respectively, achieving results superior to those using CT and MRI. The advantages of ultrasonography are noninvasiveness, simple application, low cost of devices, and the absence of contraindications.

However, the MFTD decreased as the tumor was located in the anterior region, and this may have been due to the shallow distribution of the facial nerve in the anterior regions of the parotid gland.

CONCLUSIONS

Preoperative localization of the parotid tumor in the parotid gland is very important to explain complications and the risk of postoperative facial palsy before surgery.

We proposed a new method to preoperatively differentiate parotid tumors into deep and other tumors using ultrasonography.

The diagnostic criterion: when the minimum thickness of the normal parotid gland tissue between the parotideomasseteric fascia and tumor (minimum fascia-tumor distance: MFTD) is 3 mm or more on US (a deep tumor) diagnosis, is very simple and the accuracy and sensitivity were high (89 and 85%, respectively).

However, the MFTD may be small even if the lesion is a deep tumor when it is located in the anterior region of the parotid gland, to which attention should be paid on diagnosis.