

# Mucous and ciliated cell metaplasia in epithelial linings of odontogenic inflammatory and developmental cysts

Yasunori Takeda<sup>§</sup>, Yuko Oikawa<sup>§</sup>, Izuru Furuya<sup>§</sup>, Masanobu Satoh<sup>§</sup>  
and Hirotsugu Yamamoto<sup>†</sup>

<sup>§</sup>Department of Oral Pathology, School of Dentistry,  
Iwate Medical University, Morioka, Iwate, Japan

<sup>†</sup>Department of Pathology, Nihon University School of Dentistry at Matsudo, Chiba, Japan

(Received 3 March and accepted 10 May 2005)

**Abstract:** The incidence of mucous and ciliated cells in epithelial linings was examined among odontogenic inflammatory cysts (radicular cysts) and developmental cysts (dentigerous and primordial cysts). Mucous cells were found in 20.8% of all cysts examined, while ciliated cells were found in 11.4%; however, ciliated cells were always accompanied by mucous cells. The incidence of mucous cells in radicular cysts and dentigerous cysts and that of ciliated cells in radicular cysts was higher in the maxilla than in the mandible, while the incidence of mucous cells in primordial cysts and that of ciliated cells in dentigerous cysts and primordial cysts was higher in the mandible than in the maxilla. The present results regarding mucous cells and ciliated cells in the epithelial linings of intraosseous odontogenic cysts indicate a metaplastic origin, but the cause and biological significance of this phenomenon is not known. Mucous cells were present in the surface layer of epithelial linings, and intra-epithelial gland-like structures lined with mucous cells were observed in the hyperplastic regions of epithelial linings of several radicular and dentigerous cysts. Such gland-like structures lined by mucous cells in the thickened epithelial lining, which have not been demonstrated previously, resembled the glandular structures of "glandular odontogenic cysts". (*J Oral Sci* 47, 77-81, 2005)

**Keywords:** mucous cell; ciliated cell; metaplasia; odontogenic cyst; inflammatory cyst; developmental cyst.

---

## Introduction

It is well known that the epithelial linings of both inflammatory and developmental cysts of odontogenic origin are primarily composed of squamous epithelium, and various forms of metaplasia and degeneration are observed in these epithelial linings; for example, mucous cells, ciliated cells, para- and/or ortho-hyperkeratinization and formation of hyaline bodies (1,2). Of these, the incidence of mucous cells has been described previously (3-7). However, a review of the literature yielded few English language reports describing the morphologic examination of mucous and ciliated cell metaplasia of epithelial linings in odontogenic cysts. The purpose of this study was to investigate the incidence and histological findings of mucous and ciliated cells in epithelial linings of odontogenic inflammatory cysts (radicular cysts) and developmental cysts (dentigerous cysts and primordial cysts).

## Materials and Methods

Three-hundred-sixty-one cysts with well-preserved histological architecture of the cyst wall were selected from the files of the Pathology Division of the Central Clinical Laboratory of Iwate Medical University. These cysts comprised 205 radicular cysts, 130 dentigerous cysts and 26 primordial cysts. In the present study, "primordial cyst" was defined as an intra-osseous developmental

---

Correspondence to Dr. Yasunori Takeda, Department of Oral Pathology, School of Dentistry, Iwate Medical University, 19-1 Uchimaru, Morioka, Iwate 020-8505, Japan  
E-mail: ytakeda@iwate-med.ac.jp

odontogenic cyst with a non-keratinized epithelial lining and no relationship to embedded teeth. Odontogenic keratocysts (OKC) were excluded because of their biological nature; OKC is classified as a tumor in the recently revised WHO classification of odontogenic tumors (8). All materials were fixed in 20% neutral buffered formalin and were embedded in paraffin. Thin sections were stained with hematoxylin and eosin, Alcian blue (pH 2.5) and mucicarmine. In cases identified as mucous cells and/or ciliated cells, only areas devoid of moderate to severe inflammatory cell infiltrate were selected in order to exclude the possibility that mucous cell and/or ciliated cell metaplasia may have resulted from an inflammatory process. Histopathologic findings and the incidence and site of cysts with mucous cells and/or ciliated cells were recorded.

## Results

Mucous cells were present in the surface layer of the epithelial linings in numbers varying from occasional scattered cells to continuous rows of cells (Figs. 1a, 3a, 4a and 4b). In the thickened epithelial linings, solitary mucous cells were scattered in the spinous cell layer in addition to the mucous cells of surface epithelial layer (Fig. 3b and 4b). In several specimens, intraepithelial gland-like structures lined with mucous cells were observed in the polypoid hyperplastic and/or thickened regions of the epithelial linings of radicular and dentigerous cysts (Fig. 1c, 2a and 2b). Various numbers of clear or vacuolated cells were observed near the mucous cells. Of the 361 cysts, 75 exhibited mucous cells in epithelial linings, with the overall incidence being 20.8%; 37 (18.1%) of 205 radicular cysts, 31 (23.8%) of 130 dentigerous cyst and 7 (26.9%) of 26 primordial cysts (Table 1).

Ciliated cells were observed in the surface layer of the epithelial linings and formed rows of cells (Fig. 1a, 1b, 3a and 3b). They were always accompanied by mucous cells, except in 1 radicular cyst (Fig. 1d). Of the 361 cysts, 41 showed ciliated cells in epithelial linings, with the overall incidence being 11.4%; 22 (10.7%) of 205 radicular, 14 (10.8%) of 130 dentigerous and 5 (19.2%) of 26 primordial cysts (Table 1).

The incidence of mucous cells and ciliated cells in the maxilla and mandible according to cyst type is shown in Table 2. The incidence of mucous cells in radicular and dentigerous cysts and that of ciliated cells in radicular cysts was higher in the maxilla than in the mandible, while the incidence of mucous cells in primordial cysts and that of ciliated cells in dentigerous and primordial cysts was higher in the mandible than in the maxilla.

## Discussion

Odontogenic cysts have been classified into two main types based on their formation-mechanism; inflammatory and developmental (2). Radicular cysts are the most common inflammatory cysts, while dentigerous and primordial cysts are developmental cysts.

The presence of mucous cells in the epithelial linings of radicular and dentigerous cysts is well documented; they are present in 18.0% of radicular cysts (4), 39.6% of radicular cysts, 42.0% of dentigerous cysts (5) and 9.7% of radicular cysts including residual cysts (7). However, the incidence of mucous cells in primordial cysts has not been documented. In the present study, mucous cells were found in 18.1% of radicular cysts, 23.8% of dentigerous cysts and 26.9% of primordial cysts. The incidence of ciliated cells, which were always accompanied by mucous cells, in the epithelial linings of odontogenic cysts in the present study was 11.4%, and this was in agreement with previous observations by Shear (4), although this was somewhat higher than the observation of Browne (5) who found ciliated cells in 1.0% of 638 odontogenic cysts. Such variations in the incidence of mucous cells and ciliated cells in odontogenic cysts might be due to the number of specimens examined and/or sampling for histological examination. In the present study, only areas devoid of moderate to severe inflammatory cell infiltration were selected, and several blocks were made in each case.

The present study showed that mucous cells can be present with or without ciliated cells in both inflammatory and developmental cysts in the maxilla and mandible, which is similar to the results of Browne (5). The presence of mucous cells and ciliated cells in the epithelial linings of intraosseous odontogenic cysts is thus considered to be metaplastic in origin, but the cause and biological significance of this phenomenon is not certain. Various numbers of clear or vacuolated cells were observed near the mucous cells in the present study. Such clear cells were examined in radicular and residual cysts by Slabbert et al. (7). They reported that the clear cells may represent a stage in the histogenesis of mucous cell metaplasia, and they postulated that in the initial process of metaplasia, the keratinocytes became vacuolated and mucin granules began to appear and accumulate within some vacuolated cells, ultimately leading to the formation of mucous cells (7).

In several cysts of both inflammatory and developmental origin, intraepithelial gland-like structures lined with mucous cells were observed in the hyperplastic regions of the epithelial linings. Such gland-like structures, which have not been demonstrated previously, resembled the glandular structures in "glandular odontogenic cysts (GOCs)", which

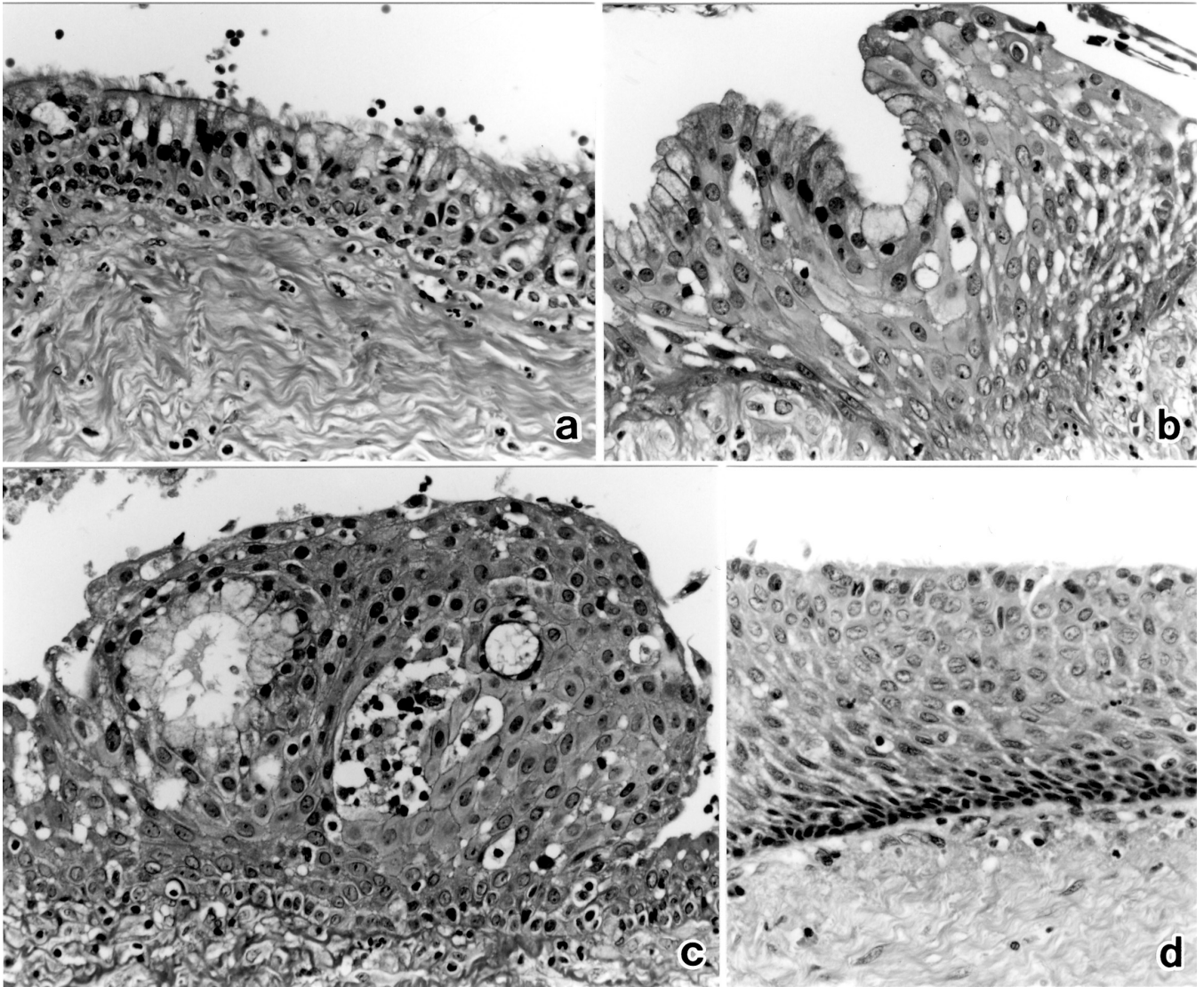


Fig. 1 Mucous and ciliated cells in epithelial linings of radicular cysts. (a) Mucous and ciliated cells in the surface layer of thin epithelial lining (HE;  $\times 150$ ). (b) Mucous and ciliated cells in the surface layer of irregularly thickened epithelial lining (HE;  $\times 200$ ). (c) Intraepithelial gland-like structures lined with mucous cells in polypoid hyperplastic regions of the epithelial lining (HE;  $\times 180$ ). (d) Ciliated cells in the surface layer of thin epithelial lining (HE;  $\times 120$ ).

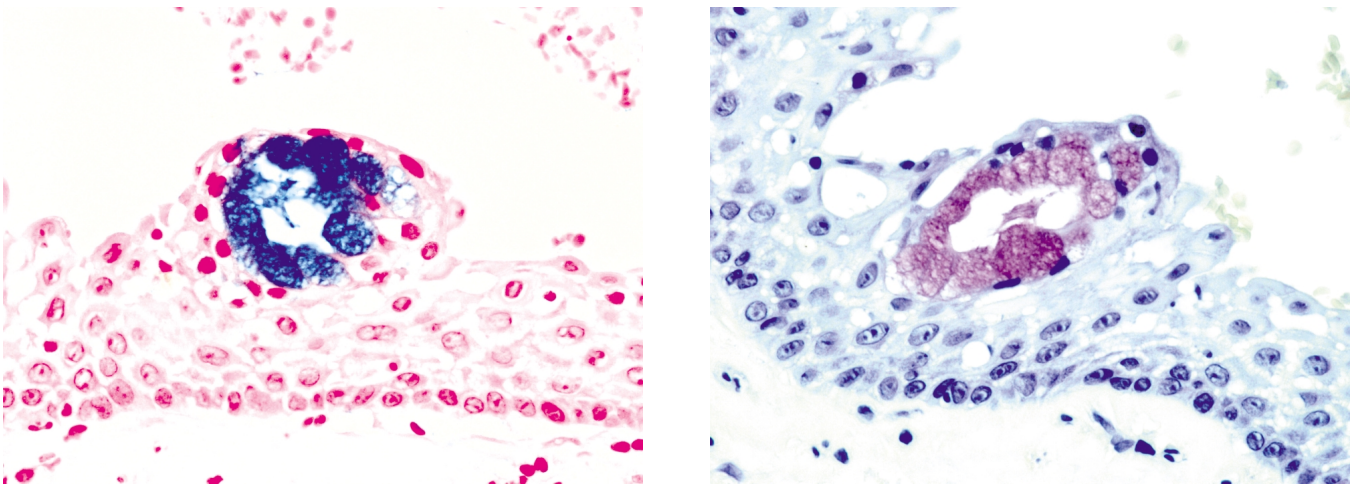


Fig. 2 Intraepithelial gland-like structures lined with mucous cells. (a) Alcian blue stain ( $\times 200$ ). (b) Mucicarmine stain ( $\times 200$ ).



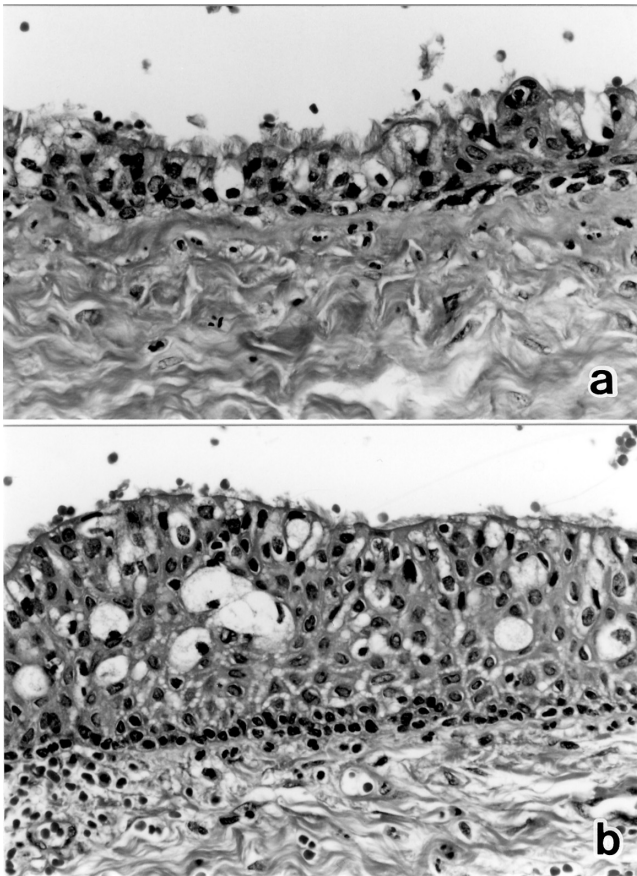


Fig. 3 Mucous and ciliated cells in epithelial linings of dentigerous cysts. (a) Mucous and ciliated cells in the surface layer of thin epithelial lining (HE;  $\times 150$ ). (b) Mucous and ciliated cells in the irregularly thickened epithelial lining (HE;  $\times 150$ ).

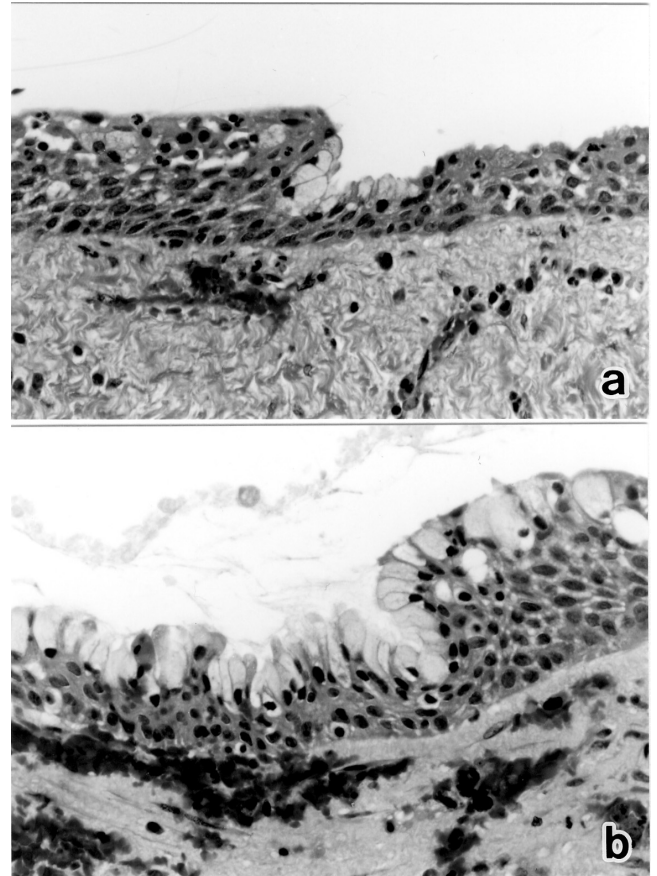


Fig. 4 Mucous cells in epithelial linings of primordial cysts. (a) Small group of mucous cells in the surface layer of thin epithelial lining (HE;  $\times 120$ ). (b) Continuous row of mucous cells in the surface layer of thin epithelial lining (HE;  $\times 150$ ).

Table 1 Incidence of mucous cells and ciliated cells according to cyst type

	Mucous cells	Ciliated cells
Radicular cysts	18.1% (37/205)	10.7% (22/205)
Dentigerous cysts	23.8% (31/130)	10.8% (14/130)
Primordial cysts	26.9% (7/26)	19.2% (5/26)
Total	20.8% (75/361)	11.4% (41/361)

Table 2 Incidence of mucous cells and ciliated cells in the maxilla and mandible according to cyst type

		Maxilla	Mandible
Mucous cells	Radicular cysts	21.0% (25/119)	14.0% (12/86)
	Dentigerous cysts	28.8% (17/59)	19.7% (14/71)
	Primordial cysts	16.7% (1/6)	30.0% (6/20)
Ciliated cells	Radicular cysts	11.8% (14/119)	9.3% (8/86)
	Dentigerous cysts	8.5% (5/59)	12.7% (9/71)
	Primordial cysts	16.7% (1/6)	20.0% (4/20)

are defined as cysts arising in tooth-bearing areas of the jaws that are lined with cuboidal to columnar epithelial cells containing mucous and/or ciliated cells and that exhibit crypt-like and microcystic spaces often lined with mucous cells (2,9). The formation of the intraepithelial gland-like structures observed in the present study, in addition to the rare presence of hyaline bodies and ghost cells in the epithelial lining of GOCs (10,11) and the multiple duct-like structures in the reduced enamel epithelia of compound odontoma (12), supports the notion that GOCs are odontogenic in origin, rather than originating from intraosseous ectopic salivary glands.

The histochemical nature of mucous cells in the epithelial linings of odontogenic cysts is currently being investigated and will be reported in a future paper.

### Acknowledgment

This study was partly supported by a Grant-in-Aid for High Performance Bio-Medical Materials Research from

the Ministry of Science, Education, Sports and Culture, Japan.

### References

1. Shear M (1992) Cysts of the oral regions. 3rd ed, Wright, Oxford
2. Kramer IRH, Pindborg JJ, Shear M (1992) Histological typing of odontogenic tumours. 2nd ed, Springer-Verlag, Berlin
3. Gorlin RJ (1957) Potentialities of oral epithelium manifest by mandibular dentigerous cysts. *Oral Surg* 10, 271-284
4. Shear M (1960) Secretory epithelium in the lining of dental cysts. *J Dent Ass South Afr* 15, 117-122
5. Brown RM (1972) Metaplasia and degeneration in odontogenic cysts in man. *J Oral Pathol* 1, 145-158
6. High AS, Hirschmann PN (1986) Age changes in residual radicular cysts. *J Oral Pathol* 15, 524-528
7. Slabbert H, Shear M, Altini M (1995) Vacuolated cells and mucous metaplasia in the epithelial linings of radicular and residual cyst. *J Oral Pathol Med* 24, 309-312
8. Shear M, Philipsen HP (2005) Keratocystic odontogenic tumour. In WHO classification of tumours, Pathology and genetics of tumours of head and neck. Barnes L, Eveson J, Reichart P, Sidransky D eds. International Agency for Research on Cancer, Lyon, 306-307
9. Sciubba JJ, Fantasia JE, Kahn LB (2001) Atlas of tumor pathology, 3rd series, fascicle 29, Tumors and cysts of the jaws. Armed Forces Institute of Pathology, Washington DC, 31-34
10. Ide F, Shinoyama T, Horie N (1996) Glandular odontogenic cyst with hyaline bodies: an unusual dentigerous presentation. *J Oral Pathol Med* 25, 401-404
11. Lindh C, Larsson A (1990) Unusual jaw-bone cysts. *J Oral Maxillofac Surg* 48, 258-263
12. Takeda Y (1991) Duct-like structures in odontogenic epithelium of compound odontoma. *J Oral Pathol Med* 20, 184-186