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Dental Anomalies in the Lesser Japanese Shrew-Mole *Dymecodon pilirostris* (Mammalia, Talpidae), with the First Record of an Extra Tooth

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Abstract Dental anomalies in Talpidae have been well studied in Talpini and Scalopini moles. Dental anomalies in such moles are frequent as absent, extra, or connate teeth. However, dental anomalies are rarely reported in Urotrichini shrew-moles and are less frequent than in Talpini and Scalopini moles. In this study, dental anomalies were examined in 280 specimens of lesser Japanese shrew-mole *Dymecodon pilirostris* True, 1886 (Mammalia, Eulipotyphla, Talpidae, Urotrichini). Six (2.1%) specimens showed dental anomalies. Tooth absence was observed at I^3 in one specimen, C^1 in three specimens, and C_1 in one specimen. An extra tooth was found posterior to the C_1 in one specimen. This is the first report of an extra tooth in this species. It was suggested that *D. pilirostris* exhibits a notably low frequency of dental anomalies, similar to *Urotrichus talpoides*, in contrast to the higher frequency observed in the Talpini and Scalopini moles. Furthermore, these results suggest that absent and extra teeth are prevalent among the canines and third incisors of Urotrichini shrew-moles.
Key words: absent tooth, extra tooth, Urotrichini.

Introduction

While most mammalian orders show low frequencies of dental anomalies (Feldhamer *et al.*, 2020), Talpini and Scalopini moles exhibit significantly higher rates. For example, anomalies occur in 22.9% of *Talpa altaica* ($n=1789$), 17.5% of *Mogera tokudae* ($n=57$), 9.9% of *M. robusta* ($n=241$), 6.4% of *M. wogura* ($n=687$), 14.5% of *Scalopus aquaticus* ($n=249$), and 8.7% of *S. latimanus* ($n=265$) (Kawada *et al.*, 2006, 2011; Feldhamer and Towery, 2011; Asahara *et al.*, 2012). Exceptions include *M. imaizumii* (1.8%, $n=331$) and *Scapanus orarius* (1.2%, $n=81$) (Hall, 1940; Kawada *et al.*, 2011). In contrast, the frequency in Urotrichini is much lower (1.7% in the greater Japanese shrew-mole *Urotrichus talpoides*) (Okabe *et al.*, 2021). Okabe *et al.* (2021) recently reported on this variation and suggested that the variation in frequencies may be related to taxonomic differences between Talpini and Scalopini moles and Urotrichini shrew-moles of the family Talpidae. In this study, the first aim was to examine the occurrence and type of dental anomalies in *Dymecodon pilirostris*, another species of the tribe Urotrichini of the family Talpidae, to verify the difference in frequency between the three tribes. The position where the dental anomalies occurred differed between *U. talpoides* and Talpini and Scalopini moles. Although dental anomalies usually occur in the third incisor in *U. talpoides* (Okabe *et al.*, 2021), they can also occur frequently in the premolars, especially the second premolar (Kawada *et al.*, 2011). The second aim of this study was to determine the position of

Table 1. The quick reference for the occurrence of dental anomalies in *Dymecodon pilirostris* reported by Miyao (1972) was converted to align with the two different formulae

Dental formula	Absent teeth reported by Miyao (1972)															
	Upper dentition								Lower dentition							
	I^1	I^2	I^3	C^1	P^1	P^2	P^3	P^4	I_1	I_2	I_3	C_1	P_1	P_2	P_3	P_4
Ziegler (1971)	0	0	2	1	0	—	0	0	—	0	0	6	2	—	2	0
Imaizumi and Kubota (1978)	0	0	—	2	1	0	0	0	—	0	—	0	6	2	2	0

dental anomalies in *D. pilirostris*.

In the previous study of dental anomalies in *D. pilirostris*, Miyao (1972) reported that 11 (25.4%) of 54 examined specimens collected from Mt. Yatsugatake, Honshu Island, Japan had dental anomalies: absent teeth on the upper canine (C^1) in two specimens, the upper first premolar (P^1) in one specimen, the lower first premolar (P_1) in six specimens, and the lower second and third premolars (P_2 and P_3) in two specimens. Miyao (1972) followed the dental formula I 2/1, C 1/1, P 4/4, M 3/3 = 38 proposed by Imaizumi and Kubota (1978). However, recent studies (Kawada *et al.*, 2001; Okabe *et al.*, 2021) have proposed the adoption of an alternative dental formula; I 3/2, C 1/1, P 3/3, M 3/3 = 38 (Ziegler, 1971). A previous report by Miyao (1972) reinterpreted the absent teeth as the upper third incisor (I^3), the lower canine (C_1), and the P_1 and P_3 (Table 1). The converted quick reference is provided in Table 1. In this study, I examined dental anomalies in a large number of *D. pilirostris* specimens ($n = 280$) collected from its geographic distribution.

Materials and Methods

I examined 280 *D. pilirostris* skull specimens collected in Honshu, Shikoku, and Kyushu, Japan. The examined specimens included 252 with permanent dentition and 28 with milk dentition. The specimens are stored at the Botanical Garden, Field Science Center for Northern Biosphere of Hokkaido University, Sapporo (HUNHM); the Kyoto University Museum, Kyoto University, Kyoto (KUZ); National Museum of Nature and Science, Tokyo (NSMT); Zoological collection in the Graduate School of Agriculture, Kyushu University, Fukuoka; Zoological collection in the Faculty of Agriculture and Life Science, Hirosaki University, Hirosaki; Museum of Natural and Environmental History, Shizuoka (SPMN-MA); and Zoological collection in NPO Network for Shizuoka prefecture museum of Natural History (Appendix 1). I followed the dental formula: I^1, I^2, I^3, C^1, P^1, P^3, P^4, M^1, M^2, M^3 / I_2, I_3, C_1, P_1, P_3, P_4, M_1, M_2, M_3 = 38 for normal dentition (Ziegler, 1971). Surface observations of the upper and lower dentition were made under a microscope, and dental anomalies were identified. Obvious postnatal tooth loss, whereby tooth roots or alveoli remained on the surface of the jaws, was excluded, following the procedure described by Kawada *et al.* (2011).

Results and Discussion

Six of the 280 specimens (2.1%) had dental anomalies (Table 2). Tooth absence was observed in five specimens, and an extra tooth was found in one specimen. A single dental anomaly was observed in each individual with a dental anomaly. All dental anomalies were found in specimens with permanent dentition. Tooth absence occurred on the right I^3 (NSMT-M12510, collected from Mt. Hayachine) (Fig. 1a), bilateral C^1 (NSMT-M14561, collected from Mt. Fuji) (Fig. 1b), right C^1 (NSMT-M13184, locality uncertain; SPMN-MA0053, collected from the South Alps) (Fig. 1c, d), and left C_1 (NSMT-M2509, collected from South Alps) (Fig. 1e). An extra tooth occurred posterior to C_1 (between C_1 and P_1) on the right side (NSMT-M29114, collected from Mt. Fuji) (Fig. 2). The extra tooth was slender with a tiny single cusp that seemed to be conge-

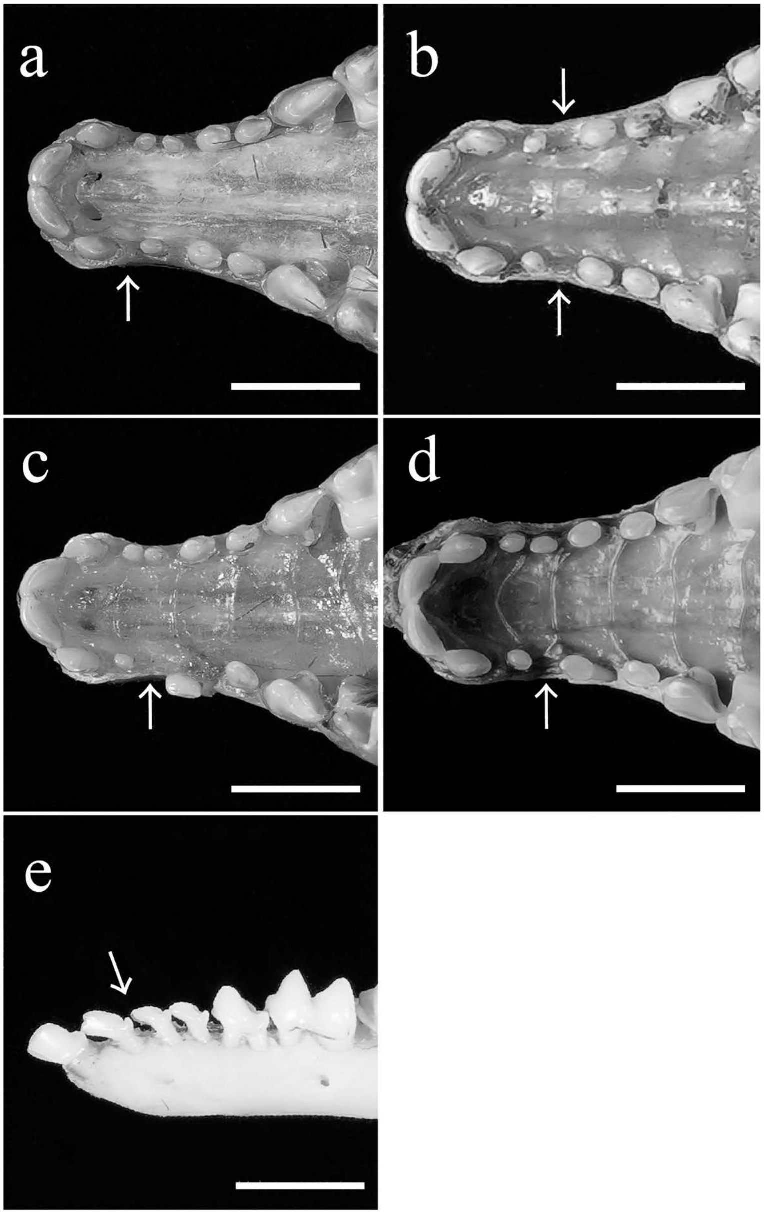

Fig. 1. Five *Dymecodon pilirostris* specimens with absent teeth (arrows). A tooth was absent at the upper third incisor (I^3) on the right side (a; NSMT-M12510), upper canine (C^1) on the right and left side (b; NSMT-M14561), C^1 on the right side (c; NSMT-M13184), C^1 on the right side (d; SPMN-MA0053), and lower canine (C_1) on the left side (e; NSMT-M2509). The scale bars represent 2 mm.

neric with P_1.

The frequency of dental anomalies in *D. pilirostris* was 2.1% in this study. This is similar to the 1.7% found in *U. talpoides*. This frequency of dental anomalies in two Urotrichini species of shrew-moles suggests a lower frequency than that of some Talpini and Scalopini mole species such as *T. altaica* (22.9%), *M. tokudae* (17.5%), *M. robusta* (9.9%), *M. wogura* (6.4%), *S. aquaticus* (14.5%), and *S. latimanus* (8.7%) (Kawada *et al.*, 2006, 2011; Feldhamer and Towery, 2011; Asahara *et al.*, 2012). The reasons for the differ-

Table 2. The number of *Dymecodon pilirostris* specimens with absent or extra teeth observed in this study following the dental formula of Ziegler (1971)

Dental anomaly	$n = 280$	Anomaly tooth			
		I^3	C^1	C_1	between C_1 and P_1
Absent teeth	5	1 (right)	3 (1 bilateral, 2 right)	1 (left)	—
Extra teeth	1	—	—	—	1 (right)

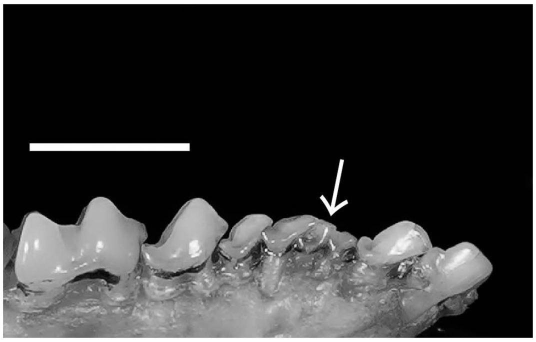

Fig. 2. A *Dymecodon pilirostris* specimen with an extra tooth (arrow). The extra tooth was found posterior to the C_1 (between C_1 and the lower first premolar (P_1)) on the right side (NSMT-M29114). The extra tooth was slender with a tiny single cusp, which seems congeneric with P_1. The scale bar represents 2 mm.

ing frequencies of dental anomalies between this study (2.1% in 280 specimens) and Miyao's report (1972) (25.4% in 54 specimens) for the same species, *D. pilirostris*, remain unclear. One possible explanation could be variations in the sample locations. Miyao (1972) examined specimens from only one locality on Mount Yatsugatake, whereas the present study examined specimens collected throughout the species' distribution range. Certain local populations have been suggested to contain dental anomalies at higher frequencies than populations from others within the species' distribution range (Asahara *et al.*, 2012); Miyao's (1972) data may reflect such local dental anomalies.

This study reports, for the first time, an extra tooth in *D. pilirostris*. Tooth absence has been observed at the third incisor, canine, first premolar, and second premolar in *D. pilirostris* (this study and Miyao, 1972) following the dental formula of Ziegler (1971). This is similar to *U. talpoides*, for which dental anomalies in the third incisor, canine, and first premolars have been reported.

The most frequent anomaly position differed between *D. pilirostris* (canine) and *U. talpoides* (third incisor), suggesting that the position where the dental anomaly is more prevalent differs between Urotrichini shrew-moles (canine or third incisor) and Talpini and Scalopini moles (mainly premolars, especially the second premolars). The differences in patterns of dental anomalies, in both frequency and position, observed between the two Urotrichini shrew-mole species and the other talpid species may reflect the semi-fossorial lifestyle of the shrew-moles as opposed to the fully fossorial nature of the moles) and their unique evolutionary histories.

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Appendix 1

NSMT-M1193, 1203, 1470, 1486, 1487, 1488, 1540, 2506, 2507, 2509, 2514, 3009, 3448, 3550, 3551, 4126, 4186, 4263, 5089, 5342, 5363, 5606, 5607, 5838, 8517, 8764, 8823, 9065, 9066, 9069, 9146, 9188, 9238, 9239, 9240, 9296, 9301, 9358, 9381, 9638, 9657, 9665, 9828, 9829, 9837, 9900, 9917, 9918, 9919, 10021, 10023, 10025, 10531, 10532, 10533, 10534, 10535, 10990, 11113, 11331, 11356, 11715, 11822, 11873, 11876, 11877, 11893, 12264, 12265, 12266, 12267, 12268, 12269, 12270, 12271, 12279, 12283, 12288, 12291, 12455, 12480, 12487, 12505, 12510, 12523, 12524, 12527, 12528, 12543, 12544, 12638, 12643, 12695, 13184, 13232, 13240, 13290, 13298, 13299, 13331, 13334, 13341, 13359, 13363, 13409, 13606, 13607, 13608, 13614, 13643, 13806, 13807, 13808, 13809, 13810, 13811, 13812, 13813, 13814, 13815, 13816, 13817, 13865, 13871, 13872, 13893, 13904, 13956, 13957, 14195, 14479, 14480, 14481, 14494, 14497, 14552, 14555, 14556, 14557, 14561, 14607, 14694, 14702, 15835, 15837, 15838, 15839, 15841, 15842, 16083, 16089, 16091, 16112, 16298, 20621, 26657, 26658, 26660, 27437, 27438, 27439, 27443, 27445, 27449, 27450, 27456, 27459, 27460, 27461, 27625, 27984, 29113, 29114, 30989, 30992, 30993, 30998, 30999, 31000, 31003, 31006, 31008, 31009, 31010, 31012, 31013, 31014, 31015, 43236, 54614, 54616, 64130, 64206, 64207, 64279, 64379, 64513, 64515, 70358, 70359, 70360, 70479.

HUNHM 52542, 52543, 52544, 52545, 52546, 52547, 52548, 52549, 52550, 52551, 52552, 52554, 52555, 53051, 53052, 53053, 53054, 53055, 55799, 56132, 56133, 56176, 56177, 56178, 58839.

KUZ M11161, 11162, 11163, 11167, 11169, 11170, 11171, 13165, 13166, 13167, 13169, 13170, 13171.

Zoological collection in the Kyoto University Museum, Kyoto University MH4016.

Zoological collection in the Graduate School of Agriculture, Kyushu University 57, 59.

Zoological collection in the Faculty of Agriculture and Life Science, Hirosaki University 98Dp1, 98Dp2, 99Dp1.

SPMN-MA0044–0058.

Zoological collection in NPO Network for Shizuoka prefecture museum of Natural History npo-160, npo-191, npo-195.