

The Comparison of Skeletons of Chicken, Japanese Quail and Chicken-Quail Hybrid

著者	TAKASHIMA Yoshihiro, MIZUMA Yutaka
journal or publication title	Tohoku journal of agricultural research
volume	32
number	4
page range	139-145
year	1982-02-25
URL	http://hdl.handle.net/10097/29816

The Comparison of Skeletons of Chicken, Japanese Quail, and Chicken-Quail Hybrid

Yoshihiro TAKASHIMA and Yutaka MIZUMA

*Department of Animal Science, Faculty of Agriculture,
Tohoku University, Sendai, Japan*

(Received, October 26, 1981)

Summary

The skeletal characteristics of vertebrae, skull, pelvic girdle, pelvic limb, clavicle, sternum, and pectoral limb in chicken, Japanese quail, and chicken-quail hybrid were compared by observing both cleaned bones and Super Soft X-ray negatives. The results are as follows, (1) There are no differences in the skeletal number among chicken, Japanese quail and F_1 hybrid. (2) The sternum, pelvic girdle and clavicles of hybrid exhibit less development than those of chicken or Japanese quail. (3) The absolute size allometry of skull, pelvic limb and pectoral limb indicates that the hybrid has an intermediate shape lying between the two species.

The interspecific and intergeneric hybridizations in avian species were listed by Gray (1). The crosses between chicken ♂ and Japanese quail ♀ have been reported by several investigators (2-6). Some papers described the external characteristics such as down and plumage color in the chicken-quail hybrids (4-6). The skeletal shape, like other species-specific characters, make an important contribution to overall shape. The analysis of skeletal morphology is useful to assess how distinct they are anatomically within or between species. This paper reports the skeletal differences and the hereditary basis observed among chickens, Japanese quail, and chicken-quail hybrids.

Materials and Methods

Three male White Cornish chickens (1-1.5 years old), five male Japanese quail (20 weeks old), and five male chicken-quail hybrids (9-12 months old) were slaughtered for this study. The configuration of the skeleton was observed by the cleaned bones treated with trypsin. After the number of vertebra was counted, the length of each vertebra and the overall size of each skeletal unit were measured with calipers. The shape of vertebrae of Japanese quail and chicken-quail hybrids was also observed by a Super Soft X-ray apparatus.

Results

The skeletons of Japanese quail and chicken-quail hybrid observed by the Super Soft X-ray are shown in Fig. 1. Although the X-ray negatives were found to be very clear, there was too much contrast in them to print photographs easily. The number of vertebrae and ribs in chicken, Japanese quail and chicken-quail hybrid is precisely equal. Chicken and Japanese quail have 14 cervical vertebrae. This provides for more flexibility of the neck. The number of thoracic vertebrae in both chicken and Japanese quail is seven. Vertebra 1 and 6 are free, vertebra 2 through 5 are fused to form a single bone, and vertebra 7 is fused to the lumbosacral bone. The lumbosacral bone consists of the 7th thoracic vertebra, 12 successive segments of the lumbar and sacral regions, and the first coccygeal bone. There are 7 coccygeal vertebrae in chickens and Japanese quail. Vertebrae 2 to 6 are free and the last vertebra is fused together.

Table 1 shows the comparison of 4 skeletal units of chicken, quail, and chicken-quail hybrid. The shape of the skull is associated with larger eyes and brain

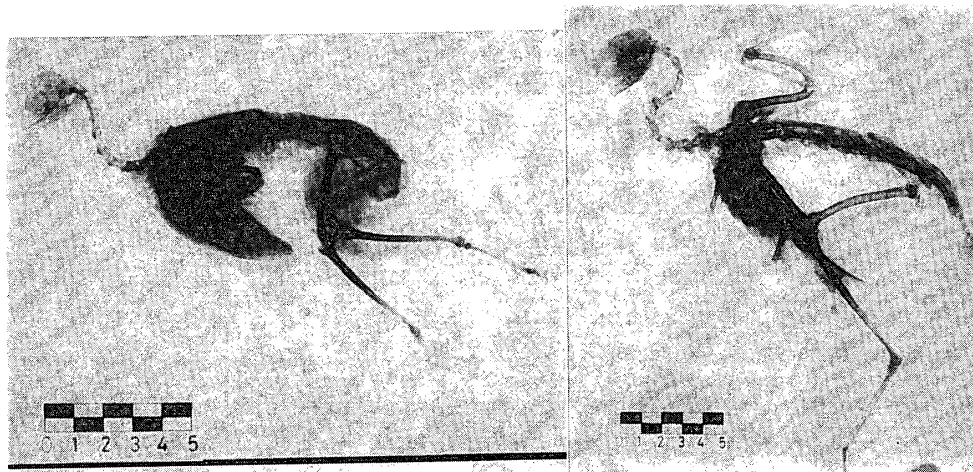


FIG. 1. The X-ray photographs of skeletons.
Left: Japanese quail Right: Chicken-quail hybrid.

TABLE 1. *The Comparison of skeletons of Chicken, Japanese quail and F₁ hybrid*

		Chicken				Japanese quail				F ₁ hybrid			
		A*	B**	C***	Ratio	A	B	C	Ratio	A	B	C	Ratio
Skull	(Dorsal)	77	38		2.03	29	18		1.61	39	22		1.77
	(Lateral)	87		32	2.72	35		14	2.50	52		20	2.60
Sternum	(Dorsal)	171	84		2.03	45	29		1.55	70	33		2.12
	(Lateral)	146		86	1.70	50		29	1.72	80		43	1.86
Pelvic girdle	(Dorsal)	145	79		1.84	40	22		1.82	72	34		2.11
	(Lateral)	147		53	2.77	41		13	3.19	76		23	3.30
Clavicles	(Caudal)	81	45		1.80	33	13		2.54	52	18		2.90

A*: Maximum length (mm), B**: Maximum width (mm), C***: Maximum height (mm),
Ratio: A/B or A/C

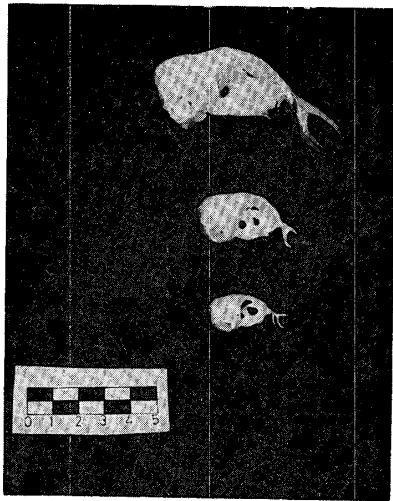


FIG. 2.

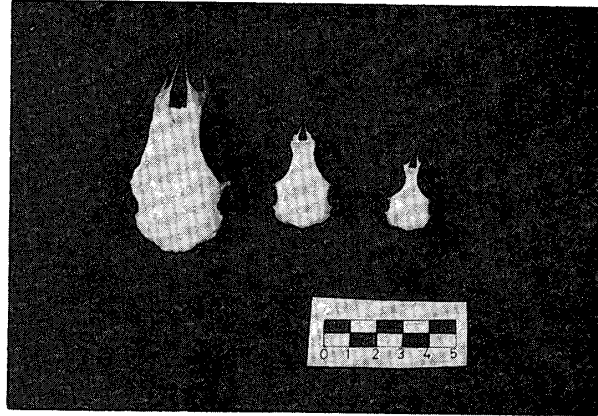


FIG. 3

FIG. 2. Lateral view of skulls. Above: Chicken. Middle: Chicken-quail hybrid. Below: Japanese quail

FIG. 3. Dorsal view of skulls. Left: Chicken. Center: Chicken-quail hybrid. Right: Japanese quail

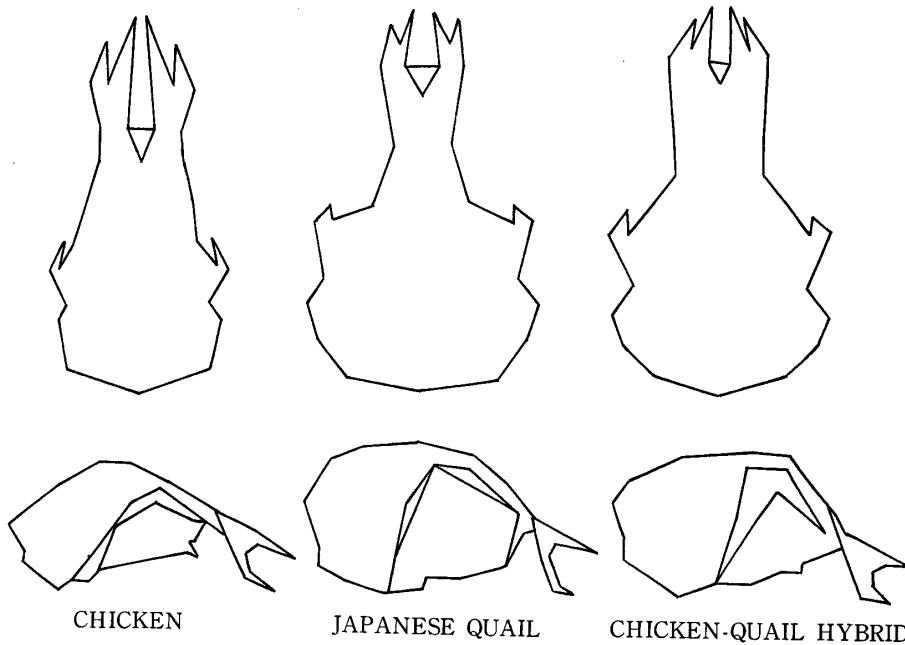


FIG. 4. The comparison of skull shapes. Above: Dorsal view. Blow: Lateral view.

sizes in both chicken and Japanese quail (Figs. 2-3). A large foramen lies in the center of the orbit in Japanese quail and F_1 hybrid, and it is found to be absent in the chicken. The skull of the Japanese quail has a greater brain capacity than that of the chicken (Fig. 4). By observing the skull measurements it is noted that the skull of F_1 hybrid has an intermediate shape lying between chicken and Japanese quail.

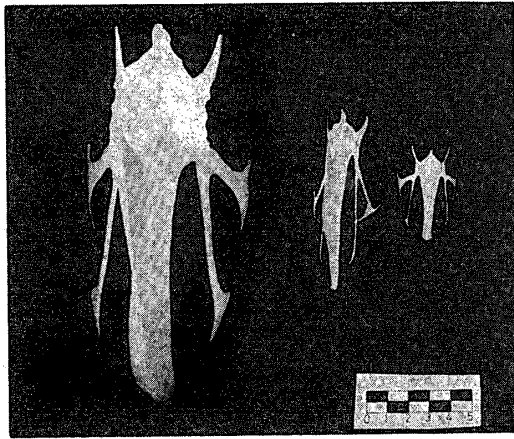


FIG. 5.

FIG. 5. Dorsal view of sternum. Left: Chicken. Center: Chicken-quail hybrid. Right: Japanese quail

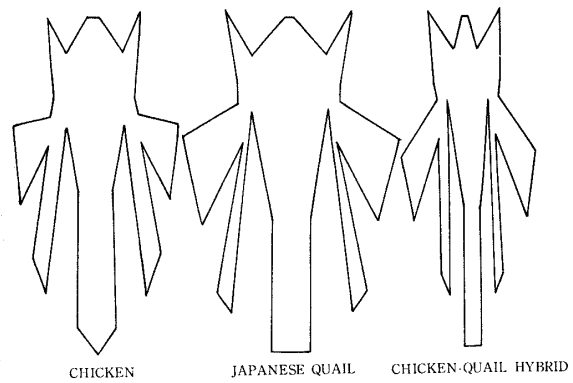


FIG. 6.

FIG. 6. The comparison of sternum shapes.

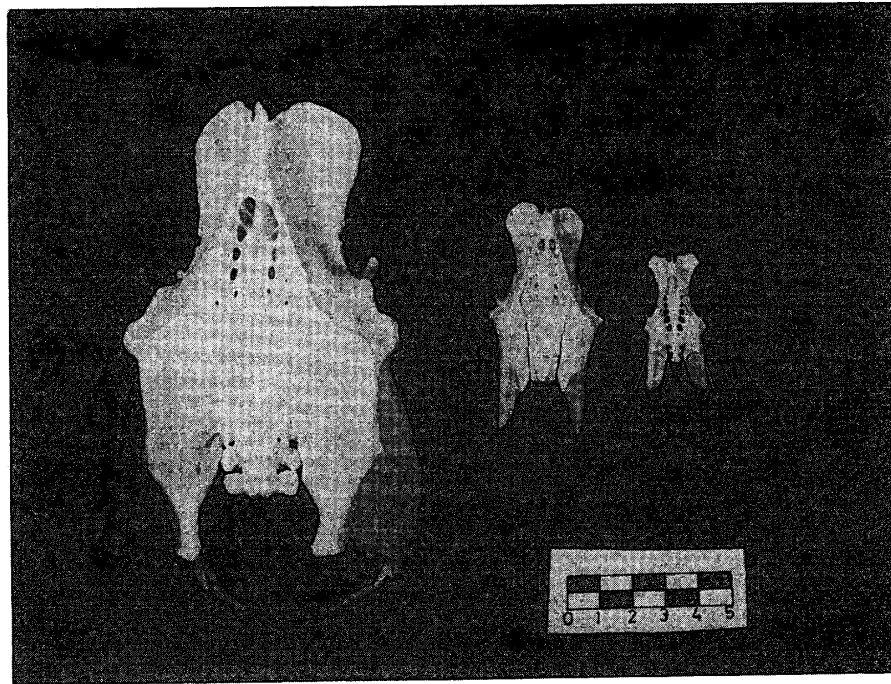


FIG. 7. Dorsal view of the pelvic girdle. Left: Chicken Center: Chicken-quail F_1 Right: Japanese quail

The sternum is a single bone connected with the breast muscles (Fig. 5). Fig. 6 shows the morphological shapes of this bone in chicken, Japanese quail, and chicken-quail hybrid. The sternum of F_1 hybrid was found to be narrow and less developed than that of chicken or Japanese quail.

Fig. 7 shows the pelvic girdle of chicken, Japanese quail, and F_1 hybrid. The plate of ishium of the chicken is at its maximum in the middle and continues to diminish to the terminal. The posterior end of the pubis turns upward and inward.

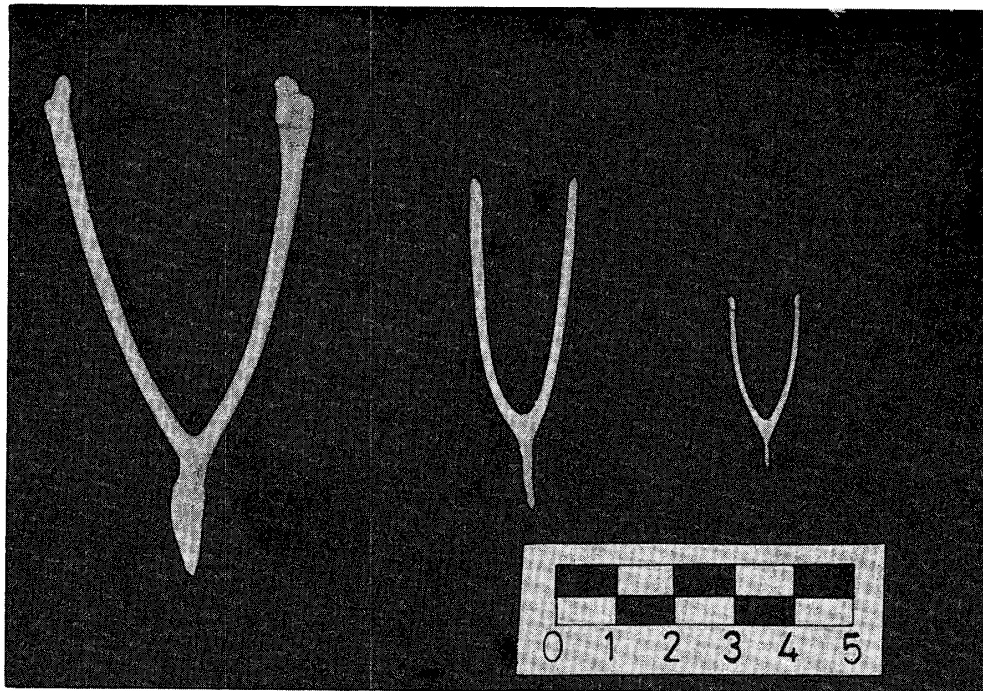


FIG. 8. Caudal view of clavicles. Left: Chicken, Center: Chicken-quail F_1 Right: Japanese quail

TABLE 2. The comparison of wing and hind leg bones of chicken, Japanese quail and F_1 hybrid

	Chicken		Japanese quail		F_1 hybrid	
	A*	B**	A	B	A	B
Pectoral limb:						
Humerus	102	28.6	34.4	31.8	55.0	30.8
Radius	93	26.2	26.3	24.3	45.3	25.4
Ulna	104	29.3	29.0	26.8	49.0	27.5
Metacarpal	56	15.8	18.6	17.1	29.0	16.3
Pelvic limb:						
Femure	119	30.3	38.0	34.5	61.0	32.1
Tibiotarsus	161	41.0	44.6	40.4	80.2	42.3
Metatarsus	113	28.6	27.7	25.1	48.6	25.6

A*: Length (mm), B**: Length/Total bone length (%)

The plate of ishium of Japanese quail and F_1 hybrid extends outward, and the pubis of these extends straight along the ishium. The pelvic girdle of the chicken is well developed.

The two clavicular bones of birds (wishbone) are a fork-like bone fused to form a body. The clavicles of Japanese quail and F_1 hybrid were U-shaped bones, while those of chicken were V-shaped bones (Fig. 8). The clavicles of F_1 hybrid exhibited less developing than those of chicken or Japanese quail.

The bone length ratio value of wing and hing leg in chicken, Japanese quail,

and F_1 hybrid is shown in Table 2. It can be seen that the bone length ratio value of the F_1 hybrid falls between the chicken and Japanese quail values. Fig. 9 shows the wing bones of F_1 hybrid observed by a Super Soft X-ray apparatus. Fig. 10 shows the pelvic limb of Japanese quail. In the case of Japanese quail and hybrid, there is no spur extending from the metatarsus as seen in the chicken.

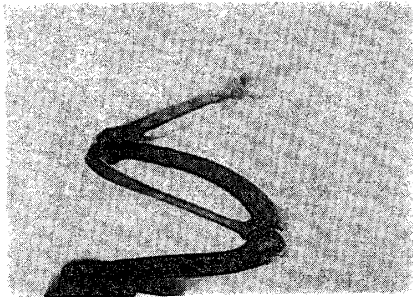


FIG. 9.

FIG. 9. The Super Soft X-ray photograph of chicken-quail F_1 wing

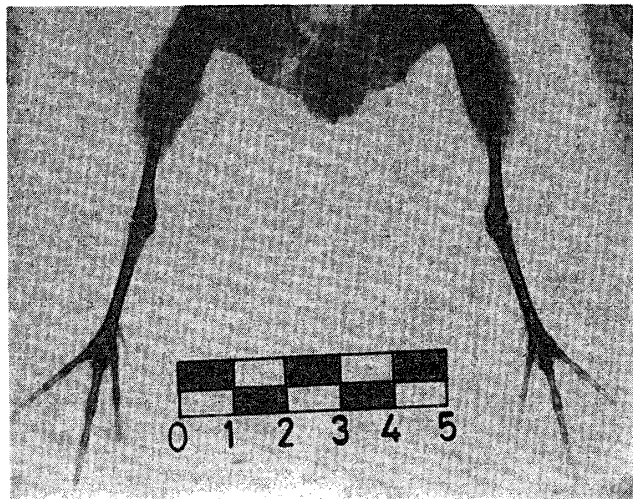


FIG. 10.

FIG. 10. The Super Soft X-ray photograph of the legs of Japanese quail

Discussion

The osteological comparison of skeletal configuration and development of animals is useful in studying close relationships between species (7). In taxonomic classification, Japanese quail and chicken belong to the same family Phasianidae, but to different genus. This comparative study shows the skeletal number of chicken and Japanese quail to be exactly equal.

The skeletal configuration and muscle development make important contributions to species-specific body shapes. The skeletal muscle length and girth of animals are closely connected to the skeletal development. The breast muscle overlying the sternum is extremely muscular in Japanese quail and the sternum is well developed. Whereas, in the chicken the thigh muscle is more developed than the breast muscle and the pelvic bone is well developed in order to carry the heavy body weight in the bipedal standing posture. However, in the F_1 hybrid there is an obvious tendency toward undevelopment in the sternum, pelvic girdle and clavicles. Thus, the incompleteness of skeletal growth of F_1 hybrid results in undeveloped musculature. The maximum weight of the F_1 hybrid is 350–480 g which is much closer to that of Japanese quail than that of chicken. The absolute size allometry of skull, wing bones, and hind leg bones indicates that the chicken-quail

hybrid possesses values which lie between those of the chicken and Japanese quail.

Servella *et al.* (8) reported that the palatability and meat quality of the chicken-quail hybrid rated higher scores than those of chicken or Japanese quail. However, as indicated above, the disadvantages of the incomplete skeletal growth as evidenced in the sternum, pelvic girdle and clavicles reveal that the chicken-quail hybrid might be unsuitable to use as a meat source.

References

- 1) Gray, A.P.: "*Bird Hybrids*", Commonwealth Agricultural Bureaux, England, (1958)
- 2) Ogasawara, F.X. and R. Huang: *Poult. Sci.*, **42**, 1386, (1963)
- 3) Haley, L.E., H. Abplanalp and K. Enya: *Evolution*, **20**, 72, (1970)
- 4) Takashima, Y. and Y. Mizuma: *Japan. Poult. Sci.*, **18**, 267, (1981)
- 5) Watanabe, S. and T. Amano: *J. Agric. Sci.*, Tokyo Nogyo Daigaku Commemoration Number of the 80th Anniversary Foundation, 91 (1971) (in Japanese)
- 6) Wilcox, F.H. and C.E. Clark: *J. Hered.*, **52**, 167, (1961)
- 7) Simizu, M.: "*Animal Growth*", Hokuryukan, Tokyo, (1957) (in Japanese)
- 8) Sarvella, P., M. Robinson, C. Davis and L. Fulton: *Poult. Sci.*, **52**, 1578, (1973)