Protofeathers were likely to have existed within the common ancestor of dinosaurs

In this paper, I comment on Barrett et al. (2015) "Evolution of dinosaur epidermal structures". Though the original authors made some very interesting results, the conclusions made by them are likely influenced by inappropriate or incorrect assumptions such as very little preserved skin fragments represent whole body covering or dinosaurian integumentary structures might represent a degraded collagen fibres. Therefore, their result might represent small size of current datas or preservational bias rather than actual evolutionary history of dinosaurian feathers.

Protofeathers were likely to have existed within the common ancestor of Dinosaurs

(Response to Barrett et al., 2015)

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Barrett et al. (2015) analyzed the current data of preserved dinosaurian soft tissues like scales, protofeathers and quills and reconstructed a phylogenetic analyzation based on these datas, concluding protofeathers are not likely to be a dinosaurian synapomorphy and ornithischian quills are not homologous with theropod feathers. Though this study is important for firstly regorously testing the hypothesis of origin of feathers in dinosauria, however, the authors should have considered more about their preservational bias or morecular analysis results.

Firstly, though it is true that there are no direct evidence of feathers in some taxa like tyrannosaurids and some fragmentary remains of these taxa preserved scales, Their scales are known from very small, fragmentary remains, mostly from underside of the body (Yun 2015). Considering that even the feathered theropods like *Sinosauropteryx* or *Juravenator* had scales underside of the body, this should not be the evidence for "absence" of the feathers of these taxa and the possibility of tyrannosaurid feathers should not be dismissed. Also, preservational environments affect a lot on preserving filamentous features like protofeathers (Zelenitsky et al., 2012). Therefore the database which Barrett et al. (2015) used can reflect small size of current datas or preservational bias rather than showing a actual distribution of feathers.

Second, though it is true that some ornithischian integumentary structures such as *Psittacosaurus* or *Tianyulong* quills are morphologically different from some theropod protofeathers (Zheng et al., 2009), they could be a secondary derived feature of protofeathers given that even obviously feathered theropods like *Epidexipteryx* had a distinct feather type which is unknown in any other theropods or birds (Zhang et al., 2008). Also, the close examination of the integumentary structures of *Tianyulong* suggests that they were very similar to protofeather morphs of therizinosaurian theropod *Beipiaosaurus* (Xu et al., 2009) and the recently described basal ornithischian *Kulindadromeus* had feather type similar to protofeathered theropod *Sinosauropteryx* (Godefroit et al., 2014). This strongly suggests that ornithischian integumentary structures were homologous with theropod feathers. Therefore, the authors' assumption that ornithischian integumentary structures might represent epidermal scales like those of squamata is seriously in question since they are no similar to these scales. Also, the possibility of dinosaurian integumentary structures could represent a degraded collagen fibres has been disputed multiple times (Zheng et al., 2009; Godefroit et al., 2014).

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Molecular analyses, evo-devo experiments and fossil records also support the hypothesis of dinosaurian-common ancestor origin of feathers. It is known that modern bird "scales" are in fact developmentally inhibited feathers (Dhauailly, 2009) and given that the ornithischian *Kulindadromeus* had the similar shaped scales in its hindlimbs (Godefroit et al., 2014), it is very possible that known dinosaurian scales were too, in fact modified feathers. So even the scaled skin impressions of many dinosaurs might not represent that their ancestors were "scaled". Also it was revealed recently that feather develoment genes predate dinosaurian origin (Lowe et al., 2014).

The authors also assumed that pterosaurian common ancestor was covered with scales in their 12 analyses and pycnofibres of pterosaurs were not homologous with protofeathers, and this might have affected their results. There is currently no evidence for common pterosaur ancestor had scales and given that it is widely assumed that almost all pterosaurs had pycnofibres (Witton, 2013), there is no reason to rule out the possibility of their common ancestor had fuzz. And regardless of differences between pycnofibres and protofeathers, there is every possibility of it being homologous with protofeathers as well (Witton, 2013; Godefroit et al., 2014).

In conclusion, though Barrett et al. (2015) made a thoughtful argument of the origin of feathers, their conclusions are not supported by current data of fossil records and might represent bias of datas and errors caused by wrong assumption.

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