

Evolution and identity of synapsid carpal bones

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To date there is little information on carpal bone homology in late Palaeozoic and Mesozoic Synapsida. Crucial to the understanding of homology in synapsid carpal elements is the fact that different nomenclatures are used for the carpals of non-mammalian Synapsida (Gegenbauer's canonical nomenclature) and Mammaliaformes (mammalian nomenclature). The homologies of the carpals of non-mammalian synapsids and mammals were established early last century and have not been reviewed since then. Here we provide a detailed study of the carpal bones of synapsids ranging in age from the early Permian to Late Cretaceous. The mammalian lunate, previously considered the homologue of the intermedium of non-mammalian synapsids, is interpreted here as homologous to their lateral centrale. We interpret the single mammalian centrale as a homologue of the medial centrale of non-mammalian synapsids. In some synapsid specimens, we found that one or two centralia are fused to the radiale (e.g., the gorgonopsian *Arctognathus* and tritylodontid *Bienotheroides*), supporting a digging habit. A third centrale is present in the therapsid *Theriongnathus*, very likely an abnormal duplication. An additional medial bone in a biarmosuchian was interpreted as a prepollex/ sesamoid. A cartilaginous prepollex/sesamoid may also have been present in several non-mammalian synapsids, which have an open space proximal to distal carpal I. Distal carpal V is completely lost in dicynodonts and it is mainly fused to distal carpal IV in the adult stage of most other therapsid groups, but showed a delayed development in most non-mammalian cynodonts. In mammalian forms, distal carpal V is not present. Our observations provide an updated revision of synapsid carpal homologies, mainly on the basis of position and anatomical contacts and also taking into account the results of embryological studies.

Key words: Synapsida, carpus, intermedium, lunate, manus, homology, Permian, Mesozoic.

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