

ANATOMY OF THE CARPAL ARTICULATION OF BUFFALO CALVES (*BUBALUS BUBALIS*)

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### ABSTRACT

Asia is the native home of the water buffaloes. The disease conditions of the joints of the limbs drastically reduce the productive and reproductive capabilities of the animals. Hence, the present study was undertaken to throw special anatomical features of carpal joint of buffalo. The study was conducted on 15 apparently healthy buffalo calves of 1 to 1½ years age to record their special morphological features compared to white cattle. The individual carpal bones had well developed articular facets. The synovial sac of inter carpal articulation and that of carpometacarpal articulation communicated with one another. In antebrachiocarpal articulation a 'λ' shaped interosseous ligament was observed connecting the depression in the middle of posterior margin of distal end of the radius with the intermediate carpal and ulnar carpal. In inter carpal articulation one interosseous ligament was observed between the non articular area on the distal surface of intermediate carpal and the non articular area of fourth carpal. Such ligaments were not reported in carpal articulation of white cattle. In carpometacarpal articulation an interosseous ligament was observed connecting the non articular area of lateral surface of the fused second and third carpal to non articular area of

proximal extremity of large metacarpal, the fibers of which blended with the interosseous ligament connecting the two carpal bones of distal row.

**Keywords:** carpal articulation, buffalo calf, interosseous ligament, carpal joint, synovial sac

### INTRODUCTION

The disease conditions of the joints of the limbs of animals drastically reduce the productive and reproductive capabilities. Extensive information is available on the anatomy of the joints of horse, dogs, pig and the cattle in standard text books dealing with anatomy and clinical anatomy (Chauveau, 1891; Raghavan, 1964; Sisson, 1975; Nickel *et al.*, 1986; Konig *et al.*, 2004; Ghosh 2006). Several anatomical aspects of joints which are specific to buffaloes and vary with those of ox are not well documented. The study was conducted to throw light on special morphological features of buffalo carpus. *Nomina Anatomica Veterinaria* (2005) followed for nomenclature.

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## MATERIALS AND METHODS

After embalming the calves with 10% formalin the gross morphology of joints and relations were studied in 15 buffalo calves of 1 to 1½ years age irrespective of the breed, sex and nutritional status by careful dissection. The age of the animal was determined based on the dentition (Chandrasekhara Rao, 2007). The dissection was also carried out in some unpreserved fresh specimens to study the movements. Four carpal articulations were cut with hack saw to study the interosseous ligaments. The ligaments of the joints were painted with acrylic paints for better visualization.

## RESULTS AND DISCUSSION

The carpal articulation (artc.) of buffalo was a composite, diarthrodial joint consisted of artc. antebrachioarpea, artc. mediocarpea, artc. intercarpea and artc. carpometacarpea. It composed of three joint cavities each with separate synovial membranes. Karimi (2002) reported the three articular sacs of carpal articulation communicate in buffalo carpus. Contrary to this in the present study only the synovial sac of artc. mediocarpea and that of artc. carpometacarpea were found to be communicated.

The dorsal carpal ligament was membranous and its superior border attached to the radius while the inferior border attached to the superior extremity of the large metacarpal. The right and left borders were united with the collateral ligaments. It was strengthened dorsally by retinaculum extensorium which surrounded the extensor tendons.

The volar carpal ligament was thick,

strong and extended from the transverse crest surmounting the articular surface of radius to the head of the large metacarpal. The retinaculum flexorium arising from the accessory carpal to bridge the sulcus carpi was attached to the bones of the carpus and the metacarpus.

The lateral collateral ligament was a flat band and attached proximally to the distal end of the radius and the styloid process of ulna and distally to the proximal end of large metacarpal and small metacarpal. Small and deeply placed proximal, middle and distal limbs of lateral collateral ligament connected the ulna and ulnar carpal, ulnar carpal and fourth carpal and fourth carpal to the large metacarpal respectively. Konig *et al.* (2004) reported the deep branches extending from the styloid process of the ulna in two limbs and one limb to the ulnar carpal and other one to fourth carpal.

The medial collateral ligament was thick, wide, and strong and extended between the styloid process of radius and proximal extremity of the large metacarpal. The small, short, deeply placed proximal, middle and distal limbs connected the distal end of radius and the radial carpal, radial carpal and the fused second and third carpal and fused second and third carpal and large metacarpal respectively. The medial collateral ligament was stronger in buffalo carpus due to the axis of the limb having a medial deviation at the carpus. This observation was similar to that of ox (Nickel *et al.*, 1986).

The artc. antebrachioarpea was a ginglymus joint formed by the radius and ulna and the proximal articular surfaces of the first row of carpal bones. The articular surface of the radius was elongated and had three oblique facets for the Radial carpal, intermediate carpal and ulnar carpal while the ulna showed single articular facet for

ulnar carpal. Accessory carpal articulated with the ulnar carpal only.

The artc. antebrachioarpea consisted of artc. radiocarpea and artc. ulnocarpea. One oblique, four posterior and one interosseous ligament were present in this articulation. The oblique ligament was ligamentum radiocarpium dorsale (lig.) extending from the dorsal aspect of the distal extremity of the radius to the ulnar carpal (Figure 1) and on volar aspect the four ligaments extended from the radius to radial carpal, radius to intermediate carpal in two bands, radius to ulnar carpal and the ulna to the ulnar carpal (Figure 2). A 'λ' shaped interosseous ligament connected the depression in the middle of posterior margin of distal end of the radius with the non articular areas of lateral surface of intermediate carpal and medial surface of ulnar carpal. Such a ligament was not reported in white cattle (Figure 3). It was reported that two oblique and three posterior ligaments were present in ox (Raghavan, 1964) and yak (Gupta and Sharma, 1990).

The artc. mediocarpea was a composite hinge joint formed between proximal and distal row of carpal bones. Two oblique anterior, four posterior and one interosseous ligament were present. Out of the two oblique ligaments one ligament extended between the radial carpal and fourth carpal and the other between the ulnar carpal and fourth carpal (Figure 1). On the volar aspect ligaments connected radial carpal to fused second and third carpal, intermediate carpal to the fourth carpal, ulnar carpal to the fourth carpal and accessory carpal to the fourth carpal (Figure 2). One interosseous ligament was observed between the non articular area on the distal aspect of the intermediate carpal and non articular area of fourth carpal. Such a ligament was not reported so far in any species as per the available literature (Figure 4).

In ox two oblique anterior, four posterior ligaments were observed (Raghavan, 1964; Ghosh, 2006).

The artcc. intercarpea were formed between the carpal bones of the same row. The articular surfaces of the carpal bones are well defined. The artcc. intercarpea proximale were plane (arthrodial) type and consisted of three ligg. intercarpea dorsalia and two ligg. intercarpea volaria. On dorsal aspect ligg. intercarpea dorsalia connected radial carpal and intermediate carpal, intermediate carpal and ulnar carpal and ulnar carpal and accessory carpal (Figure 1). On volar aspect ligg. intercarpea volaria connected intermediate carpal and ulnar carpal and ulnar carpal and accessory carpal (Figure 2). Three interosseous ligaments connected the non articular areas of the adjacent carpal bones (Figure 3). The artcc. intercarpea distale were plane (arthrodial) type and had one dorsal, one volar and an interosseous ligament between the fused second and third carpal and the fourth carpal. The interosseous ligament connected non articular areas of lateral surface of fused second and third carpal and medial surface of fourth carpal (Figure 3).

The artc. carpometacarpea was an amphiarthrodial joint formed by flattened articular surfaces of carpal bones of the distal row and those of large metacarpal. Two dorsal and two volar ligaments connected fused second and third carpal and fourth carpal separately to the large metacarpal. An interosseous ligament was present connecting the non articular area of lateral surface of fused second and third carpal to non articular area of proximal extremity of large metacarpal, the fibers of which blended with the interosseous ligament connecting the two carpal bones of distal row. In white cattle blending of the two ligaments was not reported (Figure 3). Raghavan (1964) described two anterior, two posterior and two interosseous ligaments in ox.

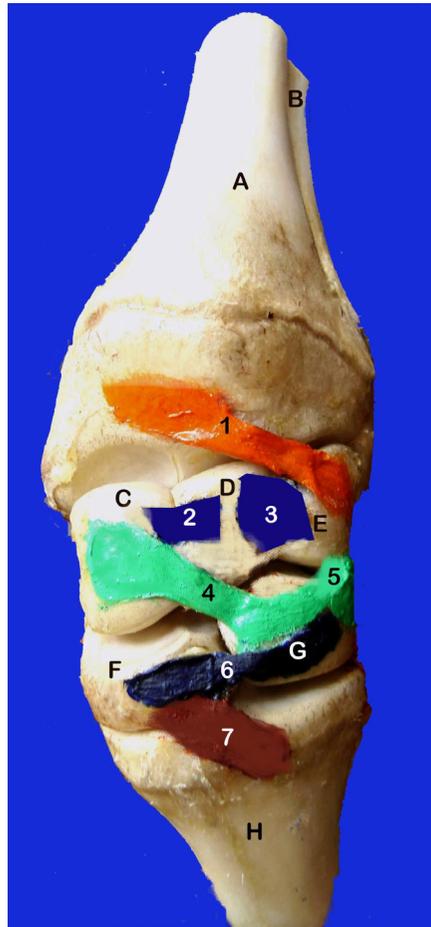


Figure 1. Photograph showing anterior aspect of the artc. carpi with capsula articularis removed.

A. Radius, B. Ulna, C. Radial carpal, D. Intermediate carpal, E. Ulnar carpal,  
F. Fused second and third carpal, G. Fourth carpal, H. Large metacarpal

1. Lig. connecting radius to ulnar carpal
2. Lig. connecting radial carpal and intermediate carpal
3. Lig. connecting intermediate carpal and ulnar carpal
4. Lig. connecting radial carpal and fourth carpal
5. Lig. connecting ulnar carpal and fourth carpal
6. Lig. connecting fourth carpal and fused second and third carpal
7. Lig. connecting fused second and third carpal and large metacarpal

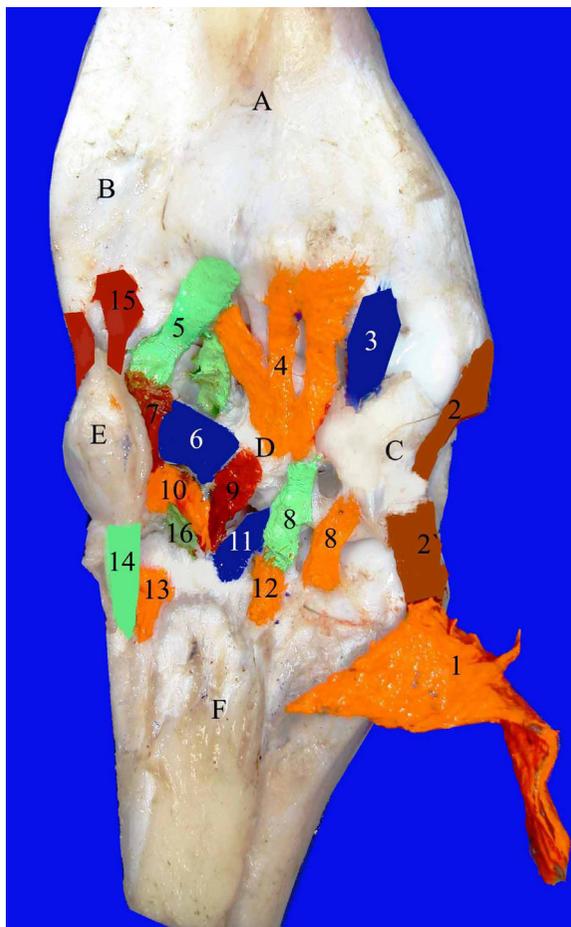


Figure 2. Photograph showing posterior aspect of the art. carpi with capsula articularis removed.

1. Medial collateral lig. (reflected) A. Radius
2. Deep branches of medial collateral lig. B. Ulna
3. Lig. connecting radius to radial carpal C. Radial carpal
4. Lig. connecting radius and intermediate carpal D. Intermediate carpal
5. Lig. connecting radius and ulnar carpal E. Accessory carpal
6. Lig. connecting intermediate carpal to ulnar carpal F. large metacarpus
7. Lig. connecting ulnar carpal to accessory carpal
8. Lig. connecting radial carpal and fused second and third carpal
9. Lig. connecting intermediate carpal and the fourth carpal
10. Lig. accessorioquadratale
11. Lig.t connecting fused second and third carpal and the fourth carpal
12. Lig. connecting fused second and third carpal and large metacarpal
13. Lig.t connecting fourth carpal and large metacarpal
14. lig. accessoriometacarpeum
15. Lig. connecting accessory carpal to the ulna
16. Lig. connecting ulnar carpal fourth carpal

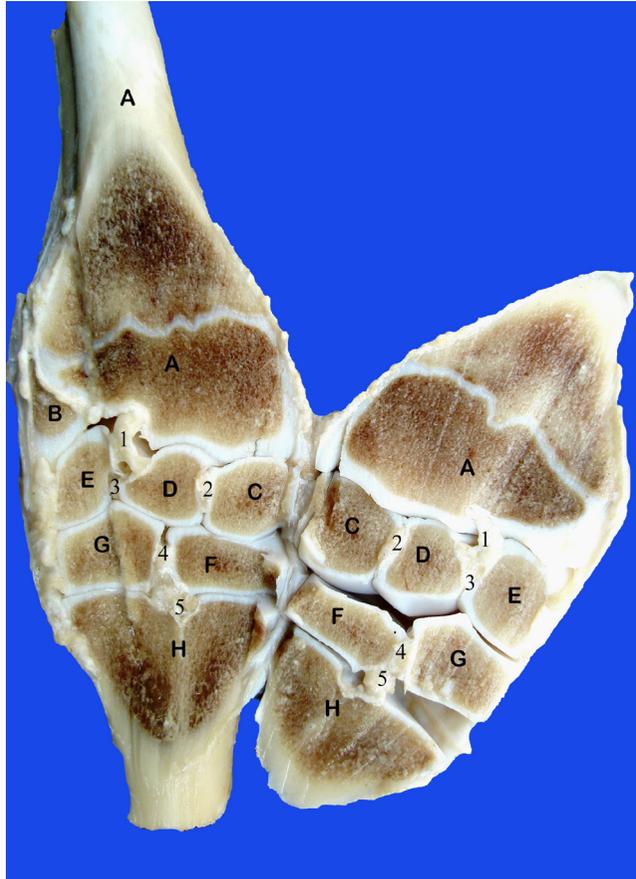


Figure 3. Photograph showing cut section of carpal articulation.

A. Radius, B. Ulna, C. Radial carpal, D. Intermediate carpal, E. Ulnar carpal,  
F. Fused second and third Carpal, G. Fourth carpal, H. Large metacarpal

1. 'λ' shaped interosseous ligament connecting the radius with both the intermediate carpal and ulnar carpal
2. Lig. connecting radial carpal and intermediate carpal
3. Lig. connecting intermediate carpal and ulnar carpal
4. Lig. connecting fused second and third carpal and the fourth carpal
5. Lig. connecting fused second and third carpal and large metacarpal

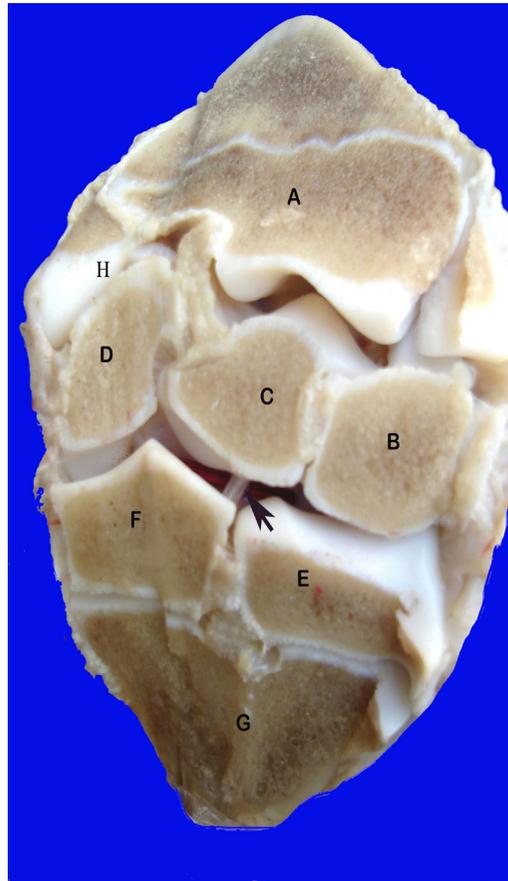


Figure 4. Photograph showing cut section of artc. carpi. Arrow indicates the interosseous ligament connecting intermediate carpal and the fourth carpal.

A. Radius, B. Radial carpal, C. Intermediate carpal, D. Ulnar carpal

E. fused second and third carpal, F. Fourth carpal, G. Large metacarpal, H. Ulna

The artc. antebrachio carpea and artc. mediocarpea showed flexion, extension, adduction and abduction. The artc. intercarpea showed slight gliding movements while, artc. carpometacarpea showed no movements. The individual carpal bones had well developed articular facets. The interosseous ligaments and collateral ligaments were strong and they limit the movement.

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