**Introduction:** Glenohumeral joint (GHJ) instability is a common shoulder disease among sports people[1]. This has been linked to pathologies of the GHJ ligaments and repairs include surgical reconstruction, re-attachment and tightening[2,3]. Surgical restoration of GHJ stability can result in loss of range of motion[4]. This may be due to poor understanding of the functional kinematics of the ligaments. Functional behavioural study of GHJ ligaments in vivo is presently difficult because the bony attachments are not clearly seen from image scans. The aim of this work was to measure and describe the relationship between the plane of the humeral head (HH) lateral margin that can be seen radiologically and that of the capsule attachment, which cannot be seen radiologically.

A modelling approach to soft-tissue repair has been applied successfully to the connective tissues of other joints and therefore, the long term aim is to use this relationship to create patient-specific models of soft tissue function of the glenohumeral joint in order to plan surgical reconstructive procedures.

**Materials and Methods:** Eight frozen cadaveric and four scanned datasets of humeri were used. The cadaveric shoulders were carefully denuded of muscle tissues without the removal of the capsule. The capsule was excised from the glenoid, longitudinally incised to the humeral attachment and reflected lateral to the HH to expose the head and the root of the capsule humeral attachment. A Faro arm digitiser (Direct Dimension Inc, Owings Mills, MD, USA) was used to trace the outlines of the cartilage lateral margin, entire cartilage surface and the margins of the root of capsule attachment. Planes were fitted numerically to the digitised cartilage rim and capsule attachment. The angle between the two planes was calculated. Sphere and circles were fitted mathematically to the entire cartilage surface and its margin, respectively. Vectors representing the entire humeral head surface and its lateral margin were obtained from digitised tomographic medical images to extract. The plane that was fit to this was compared with that produced from direct measurement using Faro Arm.

**Results:** The HH lateral margin lies on a plane with an error of 1.55 mm ± 0.4 mm, it is a circle to within 2.2% ± 0.7% of its radius and the HH is a sphere segment to within 1.2% ± 0.3% of its radius by direct measurements. The capsule attaches on a humeral plane to within an error of 1.2% ± 0.7% of its radius by direct measurements. If a coordinate system is defined on the humeral head such that x and y axes coincide with a normal to the HH margin plane and a mutual orthogonal approximately pointing toward the Fovea Capitis then, the normal to a plane fit on the capsule attachment points in the direction [0.966 0.217 0.022], demonstrating that the capsular attachment plane and the HH lateral margin plane almost share two of the cosine vectors; their relation to one another is therefore a simple rotation.

**Discussion:** Previous anatomical studies have suggested that there is a consistent attachment pattern of the origin and insertion of the glenohumeral capsule[1,5,6,7,8,9]. The quantification of the humeral head sphere fit in this study agrees with the findings of others authors[10,11]. This study has, in addition, demonstrated that the HH lateral margin and the capsule insertion lie on planes and that HH and cartilage parameters from radiographic scans and direct measurements are similar. This study shows that the HH lateral margin plane can be effectively quantified through tomographic images. A consistent relationship between this plane and the plane of capsular insertions exists that can be applied to predict the humeral insertions of ligament. These data will serve as patient-specific input to future models of glenohumeral soft tissue function, pathology and repair.

**References:**