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Background

Femoroacetabular impingement (FAI)

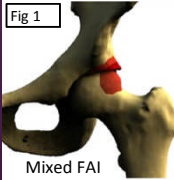
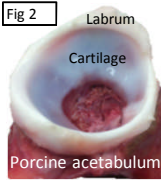
- Thought to be an initiator of osteoarthritis (OA) in the hip [1]
- Morphological abnormality on the femoral head-neck or acetabulum which impinges on the labrum (Fig 1)
- Results in altered loading patterns & damage to the tribological interface – labral tears and/or separation from the articular cartilage [2]

Labrum

- Fibro-cartilaginous rim surrounding the acetabulum
- Functions: enhancing stability & protecting the articular surface [2]

Clinical need

- Recently, evidence increasing to show labral repair is more beneficial than excision
- Repair important for maintaining function & restoring normal or near normal mechanical & physiological function

Aim of study

To provide a more complete understanding of:

- The composition of the labrum
- The structure of the labrum

In comparison to the adjacent articular cartilage

Methods

Biochemical analysis – porcine tissue 4-6mths, within 36hrs of slaughter

Femoral cartilage, acetabular cartilage & labrum in load-bearing and non-load-bearing regions

- Water content - lyophilisation
- Glycosaminoglycan (GAG) content – papain digestion & DMB Assay
- Collagen content – acid hydrolysis & p-dimethylaminobenzaldehyde assay

Histological analysis – cross-section through half the acetabulum with subchondral bone (SB), cartilage (C) and labrum (L, Fig 3a) sectioned at 6µm

Histology – NBF fixative

- Overall structure - H&E
- Collagen structure - Sirius red
- GAGs - alcian blue (labrum cross-section only – Fig 3b)

Immunohistochemistry – zinc fixative

- Collagen type I
- Collagen type II

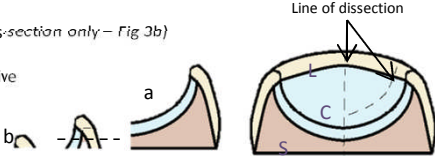


Fig 3 – Acetabulum tissue dissected for histological analysis

Biochemical Results

Biochemical Results – Table

Tissue Region	Water (%)	GAG (µg.mg ⁻¹)	Collagen (µg.mg ⁻¹)
Acetabular cartilage load-bearing	75	186 ± 50	64 ± 11
Acetabular cartilage non-load-bearing	75	197 ± 50	63 ± 23
Femoral cartilage load-bearing	76	176 ± 57	58 ± 15
Femoral cartilage non-load-bearing	75	176 ± 76	71 ± 7
Acetabular labrum load-bearing	70	67 ± 30	90 ± 21
Acetabular labrum non-load-bearing	67	29 ± 6	99 ± 16

The labrum was found to have significantly:

- Less water (10%)
- Less GAG (74%)
- Higher collagen (47%)

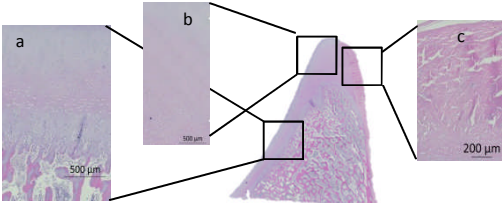
Than cartilage (acetabular & femoral)

No significant differences were found

- between the load and non-load bearing regions, within each tissue type
- between acetabular and femoral cartilage for each category

Histological Results

Fig 4 – H&E staining of the labrum a – articulating surface, b – acetabular apex, c – exterior acetabulum



Overall structure - H&E – Fig 4

- a- the main region of the articulating surface is cartilage
- b- acetabular apex is a cartilage like material similar in structure to the mid-zone of cartilage
- c – exterior acetabulum is fibrous labrum
- There is a distinct boundary between the labrum and cartilage like tissue

GAGs – alcian blue – Fig 5

- Lower GAGs in labral tissue compared to cartilage like tissue
- Labral region increases in size from the posterior to the superior region – in superior region the labrum covers the whole apex
- Vein-like pattern of GAGs through labrum

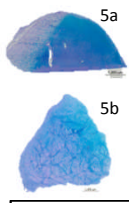
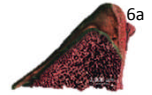


Fig 5 – Alcian blue staining of the labrum. a – posterior, b – superior

Collagen – Fig 6a

- Collagen fibres highly aligned in labrum
- Clear transition from labrum to cartilage
- Fibres at cartilage-labrum junction starting to form alignment



Collagen type – Fig 6b & 6c

- Labrum stained positive for collagen I
- Cartilage stained positive for collagen II

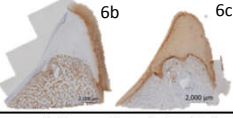


Fig 6: a - Sirius red staining of the acetabulum under polarised light, b – collagen I, c – collagen II

Conclusion

- The porcine labrum differs in structure from that reported in literature for the human labrum – possibly due to the immaturity of the tissue – in the human acetabulum the labrum forms the whole apex of the acetabulum with a distinct cartilage-labrum boundary on the articulating surface, in line with the top of the subchondral bone.
- The labrum has lower GAGs and water content and more collagen compared to cartilage suggesting it is a non-load-bearing tissue and its main function is for support.