Comparison of Four Cartilage Repair Techniques in the Human Cadaveric Hip Joint: A Biomechanical Study

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Summary:
In this study, four techniques of chondral repair on the acetabular articular surface using Fibrin glue, sutures, cyaniacrylate and an agarose hydrogel scaffold were biomechanically compared by simulating a walking cycle in the hip joint at 25% weight bearing, corresponding to the initial phase of rehabilitation.

Abstract:
Introduction:
Chondral delamination or osteochondral lesions are a common finding during hip arthroscopy in the young adult with a painful hip. The most common treatment for delaminated or detached chondral flaps is debridement and microfracture of the underlying bones to promote fibrocartilage formation. Recent studies have described techniques for repairing chondral flaps on the acetabular articular surface with fibrin glue, sutures or implanting scaffolds in the defect. Various studies, have reported on the stability of scaffold implantation in the knee joint, but none so far have reported on the biomechanical stability or durability under physiologic loading of chondral flap repairs or scaffold implantation in the hip joint. We performed a biomechanical human cadaveric study by simulating the walking cycle in the hip joint to assess and compare the stability of three different types of chondral flap repair and a hydrogel scaffold implantation on the acetabular articular surface.

Methods:
Full thickness chondral flaps were created in the geographical Zone 2 (antero-superior region) of the acetabulum in a series of human cadaveric hip joints. The chondral flap was repaired by fibrin glue (FG), cyanoacrylate (CYN) and suture (SUT) technique using 6 hips in each case. In a further series of hips (N = 6) a complete full thickness chondral defect was created in the same distribution. This area was then debrided and implanted with an agarose hydrogel scaffold (SCF) sealed with fibrin glue. After each repair, the specimens were mounted in a specially designed and validated jig and tested at 25% of the corresponding cadaveric body weight for 1500 simulated walking cycles at a rate of 15 and 10 seconds per cycle. In order to determine the stability of the repair, specimens were evaluated arthroscopically after 1, 10, 25, 50, 100, 250, 300, 400, 600, 1000 and 1500 cycles.

Results:
Although the fibrin glue and cyanoacrylate techniques was technically the easiest to perform arthroscopically, all chondral flaps repaired with FG were detached at 50 cycles while those repaired with CYN lasted for an average of 635 cycles. On the other hand, both the suture repair and scaffold implantation techniques were more technically challenging, chondral flaps repaired with the suture technique were intact after 1500 cycles. When the chondral defect was repaired with hydrogel scaffold, the repair remained stable throughout the testing until the end of the 1500 cycles.

Conclusion:
Fibrin glue on its own does not provide sufficient fixation to repair chondral flaps on the acetabular surface. Although cyanoacrylate repairs were more durable, they universally failed midway through the testing protocol employed here raising doubts as to the effectiveness of that technique. Further studies are required before recommending the use...
of cyanoacrylate intra-articular. Although more demanding, the suture technique was the most reliable technique for chondral flap repair at any given cycle, lasting for 1500 cycles in all specimens. This study also demonstrates that a hydrogel scaffolds implanted for cartilage defects on the acetabular surface was stable in all specimens for the full 1500 cycles. The results of this biomechanical study demonstrate the relative effectiveness of chondral repair and fixation techniques and should inform further in-vivo studies of fixation of chondral flaps and of the effectiveness of hydrogel scaffolds in the hip joint.