COMPARISON OF HISTOLOGICAL CHANGES ON IMMOBILIZATION AND REMOBILIZATION IN ARTICULAR CARTILAGE OF PATELLA AND SUPRAPATELLA IN RATS
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ABSTRACT

OBJECTIVE: To study the histological changes on immobilization and remobilization in articular cartilage of patella and suprapatella in rats

STUDY DESIGN: An Observational study

PLACE & DURATION: The study was carried out at the animal house College of Physician & Surgeons Islamabad from 1st Aug 2010 to 31st Dec 2010.

METHODOLOGY: Thirty male Sprague Dawley rats were procured from animal house NIH Islamabad. These animals were divided into two groups. Ten rats were included in control group and twenty in experimental group. Animals in experimental group were immobilized in plaster of paris cast. After four weeks ten rats were sacrificed. In remaining ten the plaster was removed and they were remobilized for four weeks. The slides were observed for necrotic patches, loss of staining and inflammatory cells.

RESULTS: On four weeks immobilization suprapetalla showed small necrotic patches in the centre while in patella vertical splits were seen. 10% of the patella showed loss of staining in matrix while 80% of suprapatella had lost staining in matrix. 20% of the suprapatella showed invasion of the inflammatory cells. When remobilized for four weeks necrotic patches were seen in suprapatellar and in patella vertical splits were also present in all of the specimen. Loss of staining was also seen in all of the specimen.

CONCLUSION: Suprapatellar cartilage in rats responds more to the immobilization stress as compared to patella. The equal duration of remobilization as compared to immobilization is not sufficient for regeneration both in patella and suprapatella. A much longer duration of remobilization as compared to immobilization is required for reversibility.

KEYWORDS: Rats, Patella, Suprapatella, Immobilization, Remobilization.

INTRODUCTION

Histologically, the articular cartilage is composed of chondrocytes, collagen fibers and matrix containing proteoglycans. The mature articular cartilage comprises from outer to inner the following layers; hypertrophic radial transitional and superficial layer while in immature form it lacks the radial zone. In rats the knee joint also contains sesamoid fibro cartilage known as suprapatella. It lies within the quadriceps tendon above the patella. It is an integral component of knee joint of many mammals like the mouse, rat, rabbit but it is not present in humans. These degenerative changes in knee joint have been studied by researchers over the years. Until now focus of research has been the whole cartilage. Individual zones have not been studied in detail. Earlier studies prove that articular cartilage responds to immobilization lasting from four to seven weeks. Immobilization for different periods resulted in alteration in the superficial zone of the articular cartilage but when compression was maintained for longer periods the cells of the deeper part of the cartilage were also affected, eventually involving the whole thickness, layer after layer, if immobilized for two weeks. Reductions of collagen cross links occurs, if immobilized for four weeks. Decrease in glycosaminoglycan content, if immobilized for four weeks and the reduction being largest in the superficial zone. Compared with the changes observed on immobilization which have become an established fact the available data on remobilization is disputed. Some researchers think that all the changes in cartilage are restored after a certain period of remobilization. Some work done in past shows that remobilization period of fourteen weeks did not effect the histological properties of the articular cartilage. Compared with the changes observed on immobilization of patella which have become an established fact there is no significant work done to study histological changes in suprapatella on immobilization and remobilization. Keeping this in mind this study was done to compare the histological changes in patella and suprapatella on immobilization and remobilization in rats.

METHODOLOGY

This observational study was conducted at animal house, College of Physicians and Surgeons Regional centre, Islamabad from 1st Aug 2010 to 31st Dec 2010. Ten weeks old thirty male rats belonging to Sprague Dawley species were procured from National Institute of Health Islamabad and the study was carried out at the animal house College of Physicians and Surgeons Islamabad. These animals were divided into two groups ie control group and experimental group. Ten rats were included in control group and twenty in experimental group. Animals in experimental group were immobilized in plaster of paris cast. After four weeks ten rats were sacrificed. In remaining ten the plaster was removed and they were remobilized for four weeks. They were sacrificed after four weeks of remobilization. Using a bone cutter the knee joint was cut in a way to include portions of femur and tibia.
surrounding muscles were dissected carefully to include quadriceps muscle and patellar tendon in the specimen. The knee joint was cut in sagittal plane. It was stored in 10% formalin for 48 hours. Specimens were processed and blocks were made. From each block 10 µm thick sections were taken for Alcian blue and Mallory Trichrome staining. 7µm thick sections were cut for H&E stain from the same block. The slides were observed for loss of staining, necrosis and inflammatory cells.

**RESULTS**

In the experimental group in suprapatella immobilized, in 40% of the animals the suprapatella was centrally necrosed. There were linear splits in the supra patella. In all the animals the chondrocytes had lost nuclei and in 30% there was loss of chondrocytes. Only 10% of the patella showed loss of staining in matrix while 80% of suprapatella had lost staining in matrix. 20% of the suprapatella showed invasion of the inflammatory cells. In the remobilized group there was no evidence of healing in tissue. The splits were still there in the cartilage. In the experimental group in the patella the cells were compressed and no distinct zonation can be observed. In the immobilized animals 80% of the patella necrotic changes were observed. Whole of the superficial zone was eroded and involved the transitional and radial zones. In 10% immobilized animals, the entire articular cartilage was so much destroyed that individual layers could not be identified. Large necrotic areas were observed. Loss of staining was also observed in 80% of the specimen as compared to the control group. In each group, the number of specimen which had lost staining was calculated and their percentages were calculated accordingly. In 50% of the patella large population of inflammatory cells had invaded the patellofemoral joint space. The necrotic area was flooded with inflammatory cells.

**Remobilized group**

On remobilization there was sloughing off of the cells from superficial zone. There was no healing of tissue. Large necrotic areas were still present.

**DISCUSSION**

The human knee has the tibia articulating with the femur and the patellofemoral joint which joins the patella to the femur. Patellar joint reduces friction during various movements. In rats the suprapatella articulate with the femoral condyles during flexion of the knee joint and reduces the friction. The suprapatella contains large sized chondrocytes and intermediate filaments are also present.

It has been proved in past that hyaline cartilage of femur in knee joint responds to immobilization but work done on role of suprapatella is very less. This study showed that fibrocartilage equally responds to immobilization. The suprapatella showed necrotic changes on immobilization which encompassed the whole length of the cartilage. In past it was seen that in the rat chondrocytes not only decrease in number but also become deformed even on immobilization few days in the femoral cartilage. In a study done on rabbits it was shown that after four weeks immobilization, there was pressure necrosis and marked decrease in the thickness of superficial zone in the cartilage of knee joint. It was seen in the present study that the degeneration started from the superficial zone of patella and then involved the other zones. But necrosis in suprapatella was more localized in center and necrosis more marked in patella as compared to suprapatella. Loss of staining was also marked in patella but not so in suprapatella. In past researchers have attributed loss of staining with loss of glycosaminoglycan in matrix during immobilization. Researchers have used staining as a criterion for estimation of contents of matrix. In many studies increase or decrease in staining has been taken as increase or decrease in content of proteoglycan, collagen and elastic tissue. Immobilization alters chondrocytes function and decreases the proteoglycan synthesis which causes degradation of cartilage matrix. The cause of disturbance in function of chondrocytes is interference with exchange of nutrients and waste between chondrocytes of cartilage and the synovial fluid. Surface fibrillation of articular cartilage is an early sign of degenerative changes in the development of osteoarthritis. The prominent features of necrosis were observed in this study. The splits serve as source of cells which help in regeneration. The decreased staining of matrix was an evidence of decreased proteoglycan content.

It was seen that on four weeks remobilization no reversal was seen in superficial zone and cells were sloughed off in patella. This finding can be correlated to the fact that sometimes process of degeneration goes on even on remobilization because researchers have shown that shielding or preventing the newly formed cartilage from stress also leads to better regeneration of cartilage. In both the suprapatella and patella no evidence of healing was seen on remobilization. Invasion of inflammatory cells was extensive in patella but no evidence of healing raises the question that there must be some other factor affecting the process of healing.

**CONCLUSION**

Suprapatellar cartilage in rats responds more to the immobilization stress as compared to patella. The equal duration of remobilization as compared to immobilization is not sufficient for regeneration both in patella and suprapatella. A much longer duration of remobilization as compared to immobilization is required for reversibility.
REFERENCES


