Abstract

Diabetes is a chronic disease and is one of the main contributing factors to lower back pain and degeneration of the disc in the world. Diabetes promotes advanced glycation end products (AGEs) to accumulate in the body, which causes disruption of the structural composition of the intervertebral discs (IVDs). The accumulation process of AGEs is accelerated due to diabetes. Numerous studies in animals have been conducted on how the properties of the IVD are affected by diabetes leading to its failure by inducing glycation artificially in them. However, only two studies focusing on how diabetes affects the IVD's annulus fibrosus (AF) have been completed. Therefore, the gap in the literature is that studies have only been conducted on animal models, the glycation was induced artificially, and there is very little research done on the effects of diabetes on the AF.

The main aim of this research study is to investigate how the micromechanical properties of the AF are affected by diabetes in human cadaver AF samples between the control and diabetic groups. This study was carried out using the methodology adapted from Tavakoli and Costi, 2018, where micromechanical testing was conducted at three different strain rates of $0.1\ \%s^{-1}, 1\ \%s^{-1}, and\ 10\ \%s^{-1}$, which are slow, medium, and fast test rates, respectively. After that, the specimen was subjected to a failure test of strain rate $10\ \%s^{-1}$. Tests were conducted in both tensile and shear loading directions on the CellScale BioTester machine (CellScale, Waterloo, Ontario, Canada).

The results obtained were in terms of stiffness and hysteresis loss coefficient from the non-destructive dynamic tests and peak load and energy absorbed at failure from the destructive or failure test. The specimens were exhibiting viscoelastic behaviour in both loading directions. The specimens showed higher stiffness in the diabetic group compared to the healthy specimens in the tensile direction, and the peak load at failure was approx. 30% lower for diabetic specimens in the shear direction as they are more prone to failure. The gap in the literature is bridged by conducting this study on diabetic human cadaver samples instead of animal models, and the results from this study can give a better understanding of how diabetes affects the micromechanical properties of the AF. This study can provide more in-depth knowledge and contribute to developing better techniques to help the affected patients and make their lives better.