**Supplemental Table 1:** Overview of material properties of nucleus pulposus and annulus matrix in the intradiscal disc.

|  |  |  |
| --- | --- | --- |
| **References** | **Nucleus pulposus** | **Annulus fibrosus** |
| **Model** | **Parameters** | **Model** | **Parameters** |
| Shirazi-Adl et. al, 1986 |  |  | Linear | *E*=4.2 MPa; *ν* =0.45 |
| Ueno et. al, 1987 | Linear | *E*=1 MPa; *ν* =0.499 | Linear | *E*=1 MPa; *ν* =0.48 |
| Sharma et. al, 1995 | Linear | *E*=0.2 MPa; *ν* =0.499 | Linear | *E*=4.2 MPa; *ν* =0.45 |
| Goel et. al, 1995 | Linear | *E*=1 MPa; *ν* =0.499 | Linear | *E*=4.2 MPa; *ν* =0.45 |
| Lu et. al, 1996 |  |  | Linear | *E*=4.0 MPa; *ν* =0.4 |
| Wang et. al, 1997 | Linear | *E*=2 MPa; *ν* =0.499 | Linear | *E*=4.2 MPa; *ν* =0.45 |
| Rohlmann et. al, 2006 | Fluid |  | Neo-Hookean | C01=0.348; D=0.3 |
| Schmidt et. al, 2006 | Mooney-Rivlin | C01=0.12; C10=0.09 | Mooney-Rivlin | C01=0.56; C10=0.14 |
| Schmidt et. al, 2007 | Mooney-Rivlin | C01=0.12; C10=0.03 | Mooney-Rivlin | C01=0.18; C10=0.045 |
| Little et. al, 2008 | Linear | *E*=1 MPa; *ν* =0.499 | Mooney-Rivlin | C01=0.7; C10=0.2 |
| Liu et. al, 2011 | Fluid |  | Mooney-Rivlin | C01=0.42; C10=0.105 |
| Kiapour et. al, 2012 | Linear | *E*=1 MPa; *ν* =0.499 | Neo-Hookean | C10=0.348; D1=-0.3 |
| Park et. al, 2013 | Fluid | 0.0005 *mm2/N* | Mooney-Rivlin | C01=0.18; C10=0.045 |
| Shahraki et. al, 2015 | Linear | *E*=2 MPa; *ν* =0.499 | Mooney-Rivlin | C01=0.56; C10=0.14 |
| Yang et. al, 2017 | Mooney-Rivlin | C01=0.05; C10=0.01 | Mooney-Rivlin | C01=0.20; C10=0.01 |

**Supplemental Table 2:** Overview of material properties of annulus fiber in the intradiscal disc.

|  |  |  |
| --- | --- | --- |
| **References** | **Loading direction** | **Annulus fibers (mean ± standard, MPa**) |
| **AO** | **AI** | **PO** | **PI** |
| ***Elow*** | ***Ehigh*** | ***Elow*** | ***Ehigh*** | ***Elow*** | ***Ehigh*** | ***Elow*** | ***Ehigh*** |
| Green et. al, 1993 | Vertical to disc |  | 16.4±7.0 |  |  |  | 61.8±23.2 |  |  |
| Skaggs et. al, 1994 | Parallel to fiber |  | 136 |  | 76 |  | 82 |  | 59 |
| Acaroglu et. al, 1995 | Vertical to disc |  | 27.02±14.56 |  | 7.62±3.77 |  | 13.38±9.61 |  | 2.55±2.29 |
| Ebara et. al, 1996 | Vertical to disc |  | 49.09±32.08 |  | 9.72±6.24 |  | 20.74±11.91 |  | 5.59±3.97 |
| Elliott et. al, 2000 | Vertical to disc | 2.52±2.27 | 17.45±14.29 |  |  | 1.7±1.21 | 5.6±4.67 |  |  |
| Holzapfel et. al, 2005 | Parallel to fiber | 5.96±3.05 | 77.6±20.0 | 3.79±2.61 | 27.5±12.8 | 8.01±6.50 | 64.8±48.6 | 3.8±5.02 | 31.2±19.8 |
| Skrzypiec et. al, 2007 | Vertical to disc | 3.1 |  |  | 18.6 |  |  |  |  |
| Shan et. al, 2015 | Vertical to disc |  | 13.64±4.84 |  | 4.61±2.45 |  | 12.12±4.11 |  | 4.45±1.83 |

AO represents the outer fiber layer at the anterior site of IVD; AI represents the inner fiber layer at the anterior site of IVD; PO represents the outer fiber layer at the posterior site of IVD; PI represents the inner fiber layer at the posterior site of IVD;