

Supplementary Section:

S1: Calculation of the Minimum Time Required for Regenerative Therapy using IFP-derived hADSCs

Doubling time (DT) = For IFP-derived hADSCs roughly 5 days

Number of hADSCs required for therapy (n_2) = Average defect size (550 uL) × normal concentration of chondrocytes (1.0×10^7 cells/1 mL)
 $= 550 \times 1.0 \times 10^7 / 1000$
 $= \underline{5.5 \times 10^6 \text{ cells}}$

Number of hADSCs initially isolated (n_1) = The average number of SVF cells per IFP identified in the systematic review was used, and 2% of the SVF population is used to account for hADSCs.

$$n_1 \text{ (arthroscopy)} = 0.02 \times 1.2 \times 10^6 \text{ (} 0.93 - 2.3 \times 10^6 \text{)}, = \underline{2.4 \times 10^4 \text{ stem cells [1.86 - } 4.6 \times 10^4 \text{]}}$$

$$n_1 \text{ (arthrotomy)} = 0.02 \times 3.0 \times 10^6 \text{ (} 2.8 - 4.0 \times 10^6 \text{)}, = \underline{6.0 \times 10^4 \text{ stem cells [5.6 - } 8.0 \times 10^4 \text{]}}$$

Therefore, minimum time required for cells isolated using arthroscopy:

$$\begin{aligned} \text{Minimum time (days)} &= [\text{DT} \times \ln(n_2/n_1)] / [\ln(2)] \\ &= [5 \times \ln(5.5 \times 10^6 / 2.4 \times 10^4)] / [\ln(2)] \\ &= 39.2 \text{ [34.5-41.0]} * \text{Rounded up to 40 days [35-41 days] using one IFP, 20 days [17-21 days] using two IFPs (humans have two IFPs) [10^4]} \end{aligned}$$

Therefore, minimum time required for cells isolated using arthrotomy:

$$\begin{aligned} \text{Minimum time (days)} &= [\text{DT} \times \ln(n_2/n_1)] / [\ln(2)] \\ &= [5 \times \ln(5.5 \times 10^6 / 6.0 \times 10^4)] / [\ln(2)] \\ &= 32.60 \text{ [30.5-33.1]} * \text{Rounded up to 33 days [31-33 days] using one IFP, 17 days [16-17 days] using two IFPs} \end{aligned}$$

* Error margins are represented by +/- the Standard deviation (SD).