**Discussion**  Similar to what has been observed in lupus-prone mice and IL-2−/− mice, Treg from SLE patients show the classical hallmarks of IL-2 deficiency with loss of CD25 expression and impaired homeostasis. Our in vitro results show that these Treg defects can be restored by low-dose IL-2 treatment, suggesting IL-2 as a novel therapeutic target for SLE.

**Methods**  Healthy human cartilage was co-implanted subcutaneously into the flank of SCID mice together with RASF. On the contralateral flank, cartilage was implanted without cells. After 60 days, implants and blood were analysed. Human cells were detected using immunohistochemistry for species-specific antibodies. For in vitro studies, RASF were isolated from patients with established RA and healthy controls and the expression of cellular markers were defined.

**Results**  RASF at the ipsilateral implant differentiated into distinct fibroblast subsets in the presence of cartilage. Cells proximal to cartilage expressed markers of a lining layer phenotype (GP38, FAP, VCAM-1 and Cadherin-11). These cells attached to, invaded and degraded cartilage. Cells more distal to cartilage expressed sub-lining layer phenotype markers including CD248 and CD90. Cells expressing CD248 and CD90 were never observed in the lining layer (proximal to cartilage) and never invaded cartilage. The development of this stromal architecture mirrored that observed in vivo in the inflamed synovial membrane. This stromal pattern of distinct lining layer and sub lining layer differentiation was recapitulated in the contralateral implant that contained only cartilage. In addition, we demonstrate that RASF in vitro can be directed towards either a lining layer (GP38, FAP, VCAM-1 and Cadherin-11) or a sub-lining layer phenotype (CD248 and CD90) following cytokine treatment. The lining layer, but not sub lining cell phenotype is associated with increased cartilage degradation in vitro.

**Conclusions**  RASF have an activated cell phenotype ex vivo. In vitro and in vivo they display plasticity with the capacity to differentiate into distinct cell sub-populations that morphologically distinguish between the lining and sub-lining layer of the human joint. In vivo cell sub-population differentiation occurs locally at the site of engraftment and recapitulates the lining anatomy observed at the site of origin. This phenomenon is dependent on the release of tissue factors found present in the joint microenvironment following cartilage damage. This inflammatory microenvironment is required for cartilage destruction by RASF. Cellular therapies targeting RASF specific subsets are an unexplored but important therapeutic target to modulate inflammation and may provide an avenue to minimise joint damage in patients with RA.

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