temporal cortices responsible for vision, language function, and motor coordination. Right UCS patients demonstrated increased connectivity in right BA17, BA18, BA19, BA20, BA36 when compared to controls (p<0.05). In the ROI analysis, right UCS exhibited decreased connectivity between the anterior cingulate cortex and right BA18, 19, and 37 compared to controls (p<0.05). The increased connectivity in BA17-20 (visual processing regions) supports our previous neurocognitive study results of increased visual perception abilities in right UCS patients. The subsequent decreased connectivity between BA18-19 and the anterior cingulate cortex (a section of which is implicated in complex motor coordination) is supported by neurocognitive data that shows decreased visual-motor integration ability in right UCS. This decreased connectivity between the aforementioned areas and the anterior cingulate gyrus despite increased intrinsic connectivity may also imply discordance in connecting emotion and executive function to language and visual information in right UCS patients. Connectivity between the left parahippocampus and right BA36, 37, and 54 was increased (p<0.05). Compared to controls and right UCS, left UCS demonstrated decreased connectivity between left BA6 and left BA17 and 18 (p<0.05). Left UCS patients did not demonstrate significantly different intrinsic or seed-based connectivity to right UCS or controls otherwise.

Conclusion: Unilateral coronal synostosis had decreased connectivity and greater potential for neurocognitive dysfunction in regions associated with memory, visual information processing, and motor function. Moreover, left-sided UCS had decreased connectivity in circuits crucial in complex motor movement when compared to right-sided UCS. This study provides data suggestive of long-term sequelae of UCS that varies by sidedness, which may underlie the different phenotypes of neurocognitive impairment found in previous cognitive analyses.

Purpose: Distraction osteogenesis (DO) promotes endogenous bone formation across a mechanically controlled environment, providing anatomical and functional replacement of deficient tissue. The application of DO, to the appendicular skeleton, has revolutionized the treatment of many congenital and acquired defects. Here, we describe the development of a novel mouse distraction model for the tibia.

Methods: Tibial distraction devices were manufactured using computer-aided design (CAD) software (SolidWorks) and 3D-printing (AW3D AXIOM 3D Printer). One 0.6 mm hole was drilled 3mm anterior and one 3mm posterior to a line dividing the tibial crest. An osteotomy was performed at the tibial crest using a diamond disc saw (Brasseler, Inc.). Distraction plates were secured with insertion of tight fit 0.65 mm screws (McMaster-Carr). Animals were divided into four groups: sham (exposure of the tibia and device placement without osteotomy), fracture (osteotomy without distraction), acutely lengthened, and gradually distracted. The gradual distraction protocol consisted of a 5-day latency period after the initial osteotomy and fixation of the distraction device, followed by 10 days of distraction at a rate of 0.15 mm every 12 hours, and 28 days of bone consolidation and remodeling. For our acute lengthening protocol, a 3.0 mm lengthening was performed following a 5-day latency period, with a consolidation period ending at 43 days post-operation.

Results: Bone successfully regenerated within the surgically created gap using the novel distraction device. Micro computed tomography (CT) images of the sham group presented native, unperturbed bone, while the acute lengthening group images showed the absence of bone regeneration at the site of the osteotomy. Bone regeneration occurred in the fracture group and the gradual distraction group. Upon quantitative analysis, the bone volume per tissue volume (BV/TV) (***P<0.001) and callus volume (CV) (****P<0.0001) were significantly higher in the distraction group compared to the sham group. Finally, histological staining through Movat Pentachrome determine the tissue types present within the gap of the four groups. Pentachrome staining of the acute group stained for fibrous tissue at the site of the osteotomy. Bone regeneration occurred in the fracture group and the gradual distraction group. Upon quantitative analysis, the bone volume per tissue volume (BV/TV) (***P<0.001) and callus volume (CV) (****P<0.0001) were significantly higher in the distraction group compared to the sham group. Finally, histological staining through Movat Pentachrome determine the tissue types present within the gap of the four groups. Pentachrome staining of the acute group stained for fibrous tissue at the site of the osteotomy. Pentachrome staining of the fracture group indicated an overt presence of cartilage, and the staining in the distraction group showed the formation of new bone.

Conclusions: We have developed a new model for long bone distraction osteogenesis in the mouse. Future work will include applying this model to investigate the mechanisms underlying bone regeneration, and potential therapeutics that can quicken regeneration.

Development Of A Novel Murine Distraction Device To Investigate Bone Regeneration In Long Bone Distraction Osteogenesis

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