The role of MRI and 3D modelling of the mandible in assisting personalised reconstructive surgery

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Abstract

Mandibular trauma contributes to a large proportion of maxillofacial injuries. The mandible holds a key role in mastication, communication, and appearance and therefore severe injury can be highly disfiguring, disabling and distressing for patients. The primary treatment option for the majority of mandibular fractures is surgical intervention using an open reduction and internal fixation technique (ORIF). Increasing the personalisation of reconstructive surgery is important in ensuring effective rehabilitation and high patient satisfaction. Magnetic Resonance Imaging (MRI) provides an accurate method of visualising the mandible without exposing patients to harmful radiation. In conjunction with radiography, 3D modelling techniques can produce personalised models with the potential to aid pre-operative planning and the development of mandibular implants. The project used a Bio-CAD image-based modelling technique. Firstly, Head and Neck MRI scans were performed on two subjects. Images received from these scans were imported into the Simpleware ScanIP software whereby computer-aided design helped to generate several STL files for 3D printing. Using Fused Deposition Modelling and stereolithography, personalised 3D models of the mandible are printed for both subjects. Finite Element Analysis is then performed on the models to assess the biomechanics of mastication and the stresses endured by the mandible. Utilisation of these models in the future could lead to increased surgical success and improved patient care.

Biography

Matthew Howells is studying Medicine at the University of Exeter Medical School. He is currently in his 5th year, intercalating in BSc Sport & Exercise Medical Sciences.

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