MAGnetic Expansion Control (MAGEC) growing rod internal fracture – a pictorial review of an important mechanism of device failure

R Meshaka¹ (BSc, MBChB)  L Ramsay² (BM, PGCert, FRCR)  J Russell³(BSc MBChB)  M Easty² (MBBS BSc MRCP FRCR)

Purpose
MAGEC rods are increasingly used to stabilise scoliosis in growing paediatric patients in order to avoid the need for repeat surgery. The purpose of this educational poster is to illustrate subtle and easy-to-miss fractures of the internal mechanism of the MAGEC rod, which often require surgical attention. Identification of these avoids delays to treatment and allows appropriate surgical planning to take place before further complications arise.

What is the MAGEC system?
A magnetically controlled spinal bracing and distraction system used in children over 2 years old with early onset scoliosis (EOS). As the child grows, the system allows for distractions (lengthening) to take place in outpatient clinic approximately every 3 months, without the need for sedation or anaesthesia. The system has been shown to prevent the progression of scoliosis and avoid repeated surgery which would otherwise be required for conventional growth rods. Once the child has fully grown, the system is removed and replaced by a static spinal fixation device.

Why are we seeing more MAGnetic systems?
The MAGEC system has been recommended by NICE since 2014 with the major benefit of avoiding repeat surgeries for growth rod lengthening, which means a reduction in hospital stays and surgical complications, and overall improved quality of life. It is also offering a cost saving from 3 years after insertion by approximately £12,000.

What does the MAGEC system consist of?
1 or 2 titanium growth rods with a distraction element containing a cylindrical magnet + wand locator + an external remote control for non-invasive lengthening. There is also a manual distractor to test the implant prior-lengthening.

Case Explanations
We present a case series from our institution whereby the internal distraction rod of the MAGEC system has fractured. These are visible on plain films, but subtle and easy to miss if not systematically searched for.

Case 1 (Fig 2)
(a) Normal appearance of MAGEC system growth rod as in AP thoracolumbar radiographs. (b) Fracture of the internal rod 6 months after insertion as a result of the distraction rod. This patient, who was 8 years of age, required removal of the rod and insertion of an intervertebral cage for progression of the deformity. (c) Radiographs showing the distraction rod fracture and the endplates of the vertebral bodies above and below the fracture site. (d) CT scan showing the bone fragments, also demonstrating the location of the implant.

Case 2 (Fig 3)
Intervertebral distraction system (MAGEC). The system consists of two or less growth rods fixed to the outer Cr of each vertebral pedicle with a rod ortholite magnet and distraction rod (a). The distracted distraction rod should be removed as in plain film for complications (b), with special attention paid to the side border of the distraction rod and distraction rod head, which protrudes downwards adjacent to the magnetic housing.

Why is this important for Radiologists?
Conventional rod complications are well documented and can normally be easily demonstrated on plain film. However, the complex internal mechanism in the MAGEC devices is more subtle on plain film. Missing an internal fracture (the most common cause of failure) can lead to unnecessarily delayed or inappropriate treatment.

Case 3 (Fig 4)
Internal distraction rod fractures. (a) Demonstrates left 1st left internal fracture and a suspiouus right internal fracture. This was confirmed when migrated 6 months later when the distraction rod had migrated (b). (c) Fracture of the left MAGEC rod system in a patient who was 8 years of age. (d) CT scan showing the bone fragments and also demonstrating the location of the implant.

Case 4 (Fig 5)
Fractures of the internal and main left MAGEC rod seen on different projections. (a) Demonstrates a fracture of the internal rod in the left MAGEC rod (b) Lateral projection allowing a better appreciation of the fracture line. (c) CT scan showing the bone fragments, also demonstrating the location of the implant.

Conclusion
With the rise in use of these devices, general radiologists will be asked to report plain films of children who have had MAGnetic devices inserted. Most general radiologists will know how to look at radiographs and identify loosening and fractures. However, the review of MAGnetic rods will be new to many. As always, two views are valuable and the use of magnification for subtle fractures are also helpful.

Always check just inferior to the head of the internal rod. All of our cases demonstrated a fracture in this location.

References