

# Recommendations for lengthening of magnetically-controlled growing rods in children with pacemakers: a safety study

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## BACKGROUND

There are no studies assessing safety of magnetic growth rod (MGR) lengthening procedures in children with pacemakers. Paediatric pacemakers have two modes: tonic and normal.

## PURPOSE

Pacemakers are currently identified as a contraindication for the use of magnetic growth rods (MGRs). This arises from concern that magnetic fields generated by the MGR external remote controller (ERC) during lengthening procedures may induce pacemaker dysfunction. We investigated whether MGR lengthening affects pacemaker function, and if the magnetic field of a pacemaker affects MGR lengthening.

## OBJECTIVES

1. To assess whether MGR lengthening in the outpatient department could affect paediatric pacemaker function in a patient stimulation model
2. To assess whether MGR function is affected by the presence of a pacemaker
3. To investigate if the magnetic field of a pacemaker could affect MGR lengthening using the external lengthening device (ERC)

## METHODS

A pair of 4.5x70mm standard MAGEC magnetic growth rods were attached to a patient stimulation model and lengthened using an ERC device. Effect of MGR lengthening on pacemaker function, and pacemaker function on MGR lengthening was evaluated at different distances, using the paediatric pacemaker in all modes (tonic and normal).

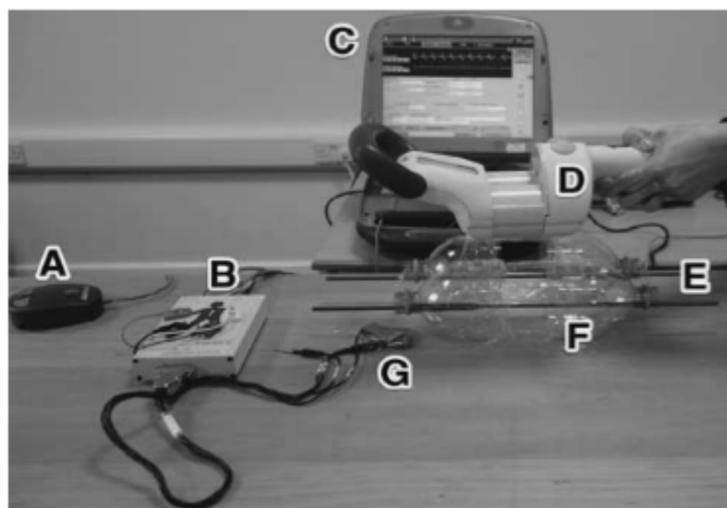


Figure 1: Experiment setup (A—pacemaker magnet; B— virtual patient; C—cardiac monitor; D—external remote controller for growing rods; F—jig; G—magnetic resonance imaging-compatible pacemaker).

## RESULTS

### MGR function in the presence of a pacemaker

Both rods were able to elongate and shorten completely by 28mm at the start and end of the experiment, taking a total of 5 minutes and 52 seconds on each occasion measured. This showed that MGR function was unaffected by any magnetic field from a pacemaker.

### Pacemaker function during MGR lengthening with an ERC

When the pacemaker was in normal mode and within a 16 cm radius of the ERC, no pacemaker dysfunction was observed at any distance. Throughout the experiment, there was only one test setup where pacemaker dysfunction occurred. This occurred while the pacemaker was in normal mode, and within a 12cm radius of the ERC.

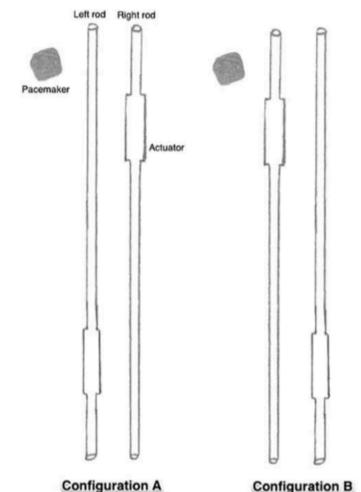


Figure 2. Rod arrangement relative to position of pacemaker.

## CONCLUSIONS

Magnetic resonance imaging compatible pacemakers appear safe for concomitant use with MGRs, provided a pacemaker technician prophylactically switches the pacemaker to tonic mode before outpatient lengthening procedures.

1. When the pacemaker is in normal mode, and within a 12 cm radius of the ERC, there is potential for pacemaker dysfunction to occur during MGR lengthening based on the results of this in vitro study. This still needs evaluating in vivo, however we recommend switching the pacemaker to tonic mode and having a pacemaker technician present during outpatient lengthening procedures in such clinical situations.
2. MGR lengthening function was unaffected by the magnetic field of a pacemaker.

## CLINICAL RELEVANCE

This experiment was designed to provide the first safety information on MGR lengthening in children with pacemakers. Although currently a rare clinical scenario, with increasing use of MGRs, this clinical scenario may arise more frequently in the future.