Eur Arch Otorhinolaryngol (2010) 267:57–59
DOI 10.1007/s00405-009-1017-5

OTOLOGY

Magnet displacement: a rare complication following cochlear implantation

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Received: 1 April 2009 / Accepted: 10 June 2009 / Published online: 27 June 2009

Abstract The purpose of this paper is to describe cases which reported complication after cochlear implantation in children: displacement of magnet from the receiver pocket, possibly aided by the use of magnetic toys. We observed magnet displacement in two female children from the same family and in one male child. Age at implantation was 23, 51, and 24 months, respectively. Magnet displacement occurred at 37, 16, and 32 months, respectively after the initial surgery. The magnets were replaced under general anaesthesia and we did not observe recurrent magnet dislodgement. Measurements indicated that forces required to remove the magnet from its pocket were not greater than those exerted by magnetic toys or the magnet used in the external sender coil. Although magnet displacement is not common after cochlear implantation, it is a major complication in children where subsequent general anaesthesia and surgery are necessary to replace the magnet. Therefore, we propose that pockets for removable magnets of cochlear implants used in children should be redesigned to increase forces to remove the magnet or that removable magnets not be used at all.

Keywords Cochlear implantation · Complication · Magnet displacement · Magnetic toys

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Introduction

Cochlear implantation has revolutionized the treatment of profound hearing loss. It has become the treatment of choice for both children and adults. The majority of patients report enhanced quality of life, and a high number of patients report open set speech recognition. Cochlear implantation also can have complications. Complications after cochlear implantation can be categorized as major or minor depending whether these require surgery. Early major complications include facial nerve paralysis, incorrect electrode placement, and wound infection. There are also late complications such as flap problems, device malfunction or infection of the middle ear cleft to name a few [1–3]. Recently, a new complication after cochlear implantation has been described, the so-called magnet migration [4–12]. In magnet migration, the implanted magnet migrates out of its central location within the internal receiver–stimulator aerial pocket. In the literature, there are several cases described with this complication mostly following trauma [4–12]. In this study, we present three cases with this rare complication and discuss whether pathogenetic mechanisms could be the use of magnetic toys or too strong on external sender coil magnet, combined with mild head trauma. For this reason we propose redesign of the magnet retaining pocket in the internal implant electronics package.

Case reports

Case 1

This young male with slight mental retardation underwent cochlear implantation on the right side (Nucleus 24

Contour, CI24RCS, Cochlear Corporation) at 23 months of age because of bilateral profound hearing loss. 11 months after surgery we noticed a skin irritation over the implant site. 37 months after surgery the displaced magnet extruded through the skin (Fig. 1). After revision surgery with replacement of the magnet the implant was fully functional.

Case 2

This young female with profound hearing loss due to a mutation in the connexion 26 gene as well as psychomotorical retardation underwent cochlear implantation on the right side (Nucleus Freedom, CI24RECA, Cochlear Corporation) at 51 months of age. 16 months after surgery she presented with a dislocated magnet lateral to the receiver aerial. Although the mother first thought that the implant was not functional, as the external coil was then not aligned with the internal aerial, at no time prior or postsurgery the implant electronics was non-functional. Due to motor problems she had repeated minor head injuries. Her mother also noticed that she played with magnetic toys which she fixed to her head by placing these over the internal magnet.

Case 3

This young female is the younger sister of case 2. She has profound hearing loss due to a mutation in the connexion 26 gene and underwent bilateral cochlear implantation (Nucleus Freedom, CI24RECA, Cochlear Corporation) at the age of 24 months. Due to skin problems over the magnet site she was provided with a weaker external magnet. As in case 2 she also played with the same magnetic toys placing these over the implanted magnet. 32 months postoperatively she presented with a dislocated magnet. She also underwent successful revision surgery with the replacement of magnet. The function of implant electronic was not affected.

Discussion

Magnet displacement in children constitutes a major complication after cochlear implantation as subsequent surgery is needed for reimplantation of the magnet. What might be the pathogenetic mechanisms underlying this condition? One idea is that minor head trauma might result in magnet dislocation [4–6]. Except for one reported patient, all the affected patients are children [6]. Particularly small children suffer more minor head injuries when compared to adults. Several of the patients with magnet displacement had cerebral palsy, and therefore their poor motor control puts them at risk for head injury. Interestingly, also two out of our three patients suffer from mental retardation and it can be assumed that they also had minor head trauma from time to time. Other factors predisposing children for magnet displacement might be a smaller skull associated with a greater curvature of the skull compared to adults, their thinner scalp which offers less protection to the implant as compared to adults, and exposure to magnetic toys. Two out of our three patients played with magnetic toys placing these on their head using the forces of attraction of the implanted magnet (Toys 1 and 2 in Fig. 2). In collaboration with the implant manufacturer, we measured the forces generated from several magnetic toys to see whether these might be strong enough to displace the magnet out of its pocket in the centre of the implanted receiver-aerial. The forces at a distance of 2 mm (the typical skip flap thickness in children) were at 4 N less than the forces (6.5 N) necessary to pull the magnet out of its pocket (Fig. 3). Therefore, it is unlikely that magnetic toys alone could remove the internal magnet from its pocket. Nonetheless the fact that two

Fig. 1 CI magnet perforating the skin

Fig. 2 Figure of magnetic toys

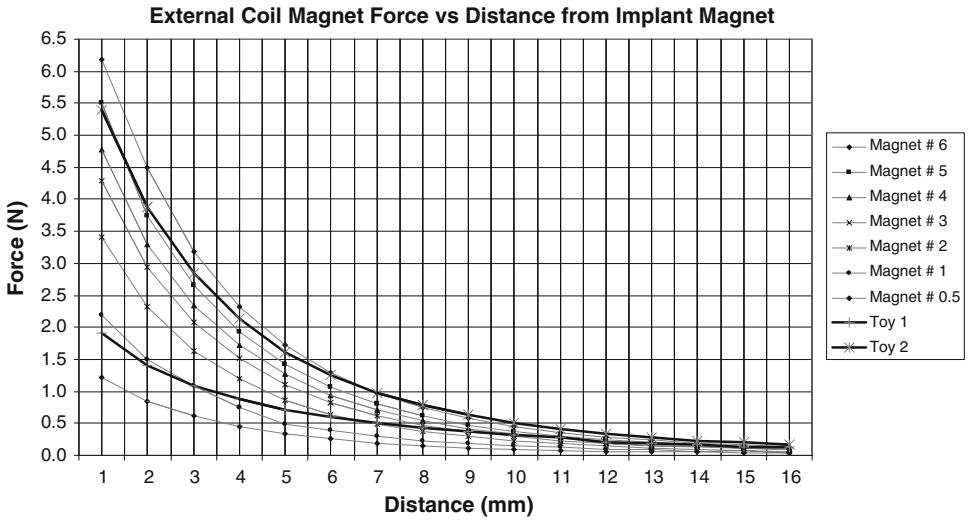

Fig. 3 Force generated by different external coil magnets and various magnetic toys

children in the same family who had played with these toys both suffered magnet displacement is suggestive of trauma causing an initial displacement which is maintained or increased with magnetic toys.

Cochlea implants with a removable magnet allow for easy magnet removal once a MRI should be necessary. We reviewed the charts from all patients who received a cochlear implant with a removable magnet from 1998 to January 2009 in Switzerland. We found that none of the patient out of 821 patients who received such cochlear implant for whom the magnet had to be removed to perform a MRI examination. Beside the fact that three magnet displacements in 821 patients point to a much higher incidence of this complication than assumed until now, it is our opinion that either cochlear implant with removable magnets should not be implanted in children or the magnet pocket be redesigned in order to avoid this major complication. A redesigned pocket would need an increased force to remove the magnet from its pocket to take into account multifactorial causes for displacement.

Conclusion

Based on the fact that magnet removal prior an MRI examination is rarely needed in children and magnet dislodgement constitutes a major complication after cochlear implant surgery, we suggest that either implant types with a removable magnet not to be implanted in children or the one should used that requires increased force to remove it from the magnet pocket.

Conflict of interest statement The authors declare that there is no conflict of interest.

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