



# A COVID Curiosity: Transurethral Insertion of Neodymium Magnets in Pediatric Patients

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## Abstract

Rare-earth metal magnets are a growing problem in the pediatric population with ingestion into the GI tract as the most prominent route. Neodymium magnet transurethral insertion has been reported in 6 pediatric patients in the literature. All of these, except one, have required an open surgical approach for removal. We provide three additional cases, all of whom have behavioral health concerns, with two patients presenting during the COVID-19 pandemic. We describe the use of a self-made magnetic device for successful retrieval of this unique foreign body from the bladder of a pediatric patient. Two patients presented in a timely manner whereas one patient presented during the pandemic but admitted to placing these magnets in his urethra a least one year prior. Clinicians should be aware of the signs and symptoms associated with this rare tendency of transurethral insertion of strong magnets in pediatric patients, the association with behavioral health diagnoses as well as environmental stressors due to the effects of COVID-19 pandemic, which may contribute to this occurrence.

## Key Points

- 1) COVID-19 pandemic and other environmental stressors increase the propensity for self-harm in patients with behavioral health disease.
- 2) Neodymium rare-earth magnets transurethral insertion is increasing in the pediatric population, which are difficult to treat endoscopically.
- 3) Clinicians should be aware of the signs and symptoms associated with this rare tendency of transurethral insertion of strong magnets in pediatric patients resulting in dysuria and difficulty with voiding in the absence of urinary tract infection and able to diagnosed by an abdominal X-ray plain film.

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## Introduction

Neodymium earth magnets, made by companies such as Bucky balls, Zen magnets, Specks and others have been popular toys for children and adults. Compared to the more commonly found ferret magnets, neodymium magnets are approximately 10 times stronger, making them useful in electric vehicle and power generator technologies [1]. The strength of the magnets and the small size of 2.5 mm in diameter contribute to their danger as foreign bodies, particularly in children [2]. Due to the dangers posed by the toys, the Consumer Product Safety Commission (CPSC) proposed a ban on Bucky balls and other neodymium magnet toys in 2012 (3, Official government document). The revised ban, which was set to take effect in April 2015, was overturned by a lawsuit in 2016, making Bucky balls, Zen magnets and the like widely available once again [3,4]. Most cases of foreign body injury involving rare earth magnets are the result of ingestion of the magnets, which can cause severe injury including bowel obstruction, volvulus, intestinal fistula and other life-threatening complications [2]. The number of patients requiring emergent care due to magnet ingestion since 2002 has also drastically increased. From 2002 to 2011, an estimated 16,386 children under the age of 18 required emergency room care as a result of magnet ingestion, with estimated ingestion increasing approximately 8.5 fold over the same time, to a rate of 3.75/100,000 children in 2011 [2,5]. The trend has continued with an estimated 14,586 emergency room visits from 2010-2015 [6]. While cases of transurethral insertion of neodymium magnets is far less common, with only 6 previous reported cases in the literature, we suspect a rise in cases, with 2/6 occurring 2019 [7] and 3 more in 2020 as described in this report.

In this manuscript, we present 3 cases of transurethral insertion of rare-earth magnets in children and the association of these cases with behavioral health issues in addition to the stress and pressure due to COVID-19 lockdown [8].

## Case Series

### Case 1

A 13-year-old extremely intelligent male patient with medically treated ADHD presented with urinary straining, dysuria gross hematuria and severe pain while being homebound during COVID-19 pandemic (October 2020). The patient admitted that he inserted an unknown quantity of Bulky balls in his urethra, with the experimental intention to withdraw them afterwards as a single unit. He was unable to withdraw all the magnets. After pulling on the string of beads, he experienced immediate bleeding. He urgently notified his parents and brought to the ED.

Upon evaluation, a KUB X-ray revealed multiple small magnets remaining in both the urethra and the bladder (Figure 1). Endoscopic treatment ensued, in which urethral dilation allowed for use of a 21 F cystoscope, in addition to grasping forceps and a Zero-tip Nitinol stone basket. Retrieval of one magnet was successful, but numerous magnets remaining in the bladder. The coalescence of magnets prevented removal using an endoscopic approach. Therefore, an open extraperitoneal cystotomy was performed with digital manipulation, resulting in removal of the remaining 62 magnets, which were located together as one mass (4 cm × 3.5 cm × 1.5 cm in size).

The patient was discharged the next day. The parents pursued counseling and expressed heightened concern of the COVID-19 effect on their son's psychological state. They felt his baseline social reservation had been heightened which further inhibited his ability to cope with the increased social isolation. When asked about the incident, the patient indicated that he had inserted the magnets out of curiosity and boredom due to the amount of free time on his hands. His parents attested that their child was very inquisitive with a propensity to spend time tinkering with electronic and mechanical equipment. They describe him as an excellent student and electronically savvy, one who takes apart malfunctioning electronic devices and fixes them without difficulty.

### Case 2

An 11-year-old, who was highly intelligent and inquisitive, was referred to an adult urologist for evaluation of recurrent urinary tract infections. At the time of initial assessment (November 2015), a KUB was obtained which demonstrated the presence of foreign bodies

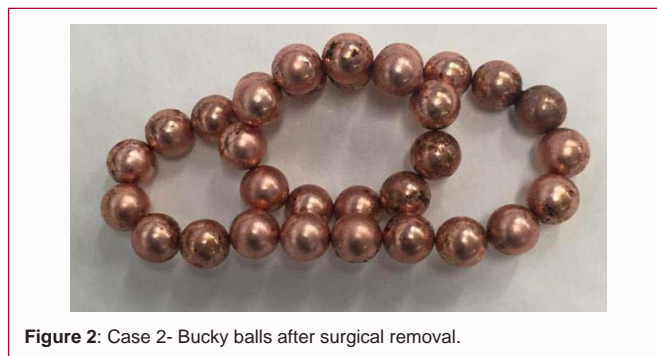


Figure 2: Case 2- Bucky balls after surgical removal.

within the bladder. The patient reluctantly admitted that he had inserted a string of Bucky balls into his urethra but believed that he had removed them all. Several weeks after the incident, he developed lower urinary tract symptoms including dysuria and urgency and frequency. The adult urologist recommended that the patient be seen by pediatric urology for further evaluation. A discussion ensued and it was recommended that initially an endoscopic approach be attempted to remove the Bulky balls. If this was not successful then an open surgical approach would be required.

The patient underwent cystoscopy and removal of each of the Bucky balls that was present in the bladder. The greatest difficulty encountered was the Bucky balls adhering to the grasping forceps, making them difficult to grasp. Eventually over the course of 2 h, all of the Bucky balls were removed (Figure 2). Lidocaine jelly was instilled within the urethra at the completion of the procedure and the patient was discharged home with instructions to drink plenty of water for the first several days following his procedure. At the time of his post-operative visit, the patient was not having any urinary tract symptoms and the family brought the remainder of the Bucky balls to the surgeon for proper disposal.

### Case 3

A 14-year-old male patient with a longstanding history of ADHD presented to the emergency room in September 2020 due to penile pain of 1 month duration and reports of black specks in his urine. His urinalysis was noted to be positive for nitrites and leukocyte esterase and he was begun on Keflex pending the results of his urine culture. This culture ultimately grew out greater than 100,000 CFU/milliliter of *Staph aureus* and his antibiotics were switched to Macrobid. A renal and bladder ultrasound had been obtained in the ED which demonstrated that his bladder was decompressed with the presence of some indistinguishable debris in his bladder and normal kidneys



Figure 1: Case 1- X-rays of 63 earth metal Bucky balls in the bladder and urethra (A-P and lateral view).



**Figure 3:** Case 3- X-ray showing long-standing Bucky balls in bladder and urethra.

without hydronephrosis.

At the time of his initial urologic consultation, an uroflow with post-void residual assessment demonstrated an abnormal staccato voiding pattern with a low peak flow of 6.7 mL/second, average flow of only 3.1 mL/second, and avoided volume of 252 mL with a significant post void residual of 223 mL. Shortly after voiding, the patient then expressed severe urgency and urinated a second time, now voiding 255 mL with a peak flow rate of 7.8 mL/s, an average flow of 4.5 mL/s, and a residual of 171 mL. The patient stated that his voiding pattern was normal for him and denied any history of urethral injury. Based upon the abnormality of his uroflow, a discussion ensued about a possible urethral stricture and the patient was scheduled for a retrograde urethrogram.

Prior to proceeding with the retrograde urethrogram, a scout film was obtained and multiple small round 2.5 mm in diameter foreign bodies were present in the anterior urethra and over the bladder in the midline pelvis (Figure 3). The radiologist questioned the patient as to the origin of the foreign bodies and the patient admitted that well over 1 year ago, he had placed magnets into his urethra and then subsequently removes them.

The patient was scheduled for cystoscopy and removal of the foreign bodies at an ambulatory surgery center affiliated with our hospital. Plans were for endoscopic retrieval of the magnets in the urethra and bladder. Initial catheterization with an 8 French straight catheter encountered significant resistance within several centimeters of the urethral meatus. This necessitated a meatotomy, so that a straight hemostat was able to retrieve the majority of the foreign body that was present within the anterior urethra. Cystoscopy with an 11 French cystoscope demonstrated no residual foreign body within the urethra but a large, calcified structure containing magnetic material within the bladder. Using 5 French grasping forceps, the calcified structure was fragmented into smaller pieces. In addition, self-made magnetic devices with Bucky balls inserted into a 14 French catheter were then used to extract a good portion of the magnetic debris present within the bladder (Figure 4). Due to the degree of calcification, the entire bladder foreign body was unable to be successfully removed. At a subsequent endoscopic procedure, a holmium laser was utilized to fragment the calcification which then allowed for retrieval of the magnetic fragments with grasping forceps. A subsequent KUB



**Figure 4:** Surgeon created (MCC) self-made magnetic device with Bucky balls inserted into a 14 French catheter for endoscopic extraction of magnetic debris within the bladder.

demonstrated that no residual fragments were present in the patient's bladder and he reported that his voiding was significantly improved.

## Discussion

There are a total of 9 patients who inserted neodymium earth magnets into their urethra, 4 of the patients presenting after 2019, including our two patients who presented during the COVID-19 pandemic. There is one report of successful endoscopic management of transurethral inserted beads in pediatrics in the literature [9]. It is worth noting that our 11-yr old patient did undergo successful endoscopic retrieval of 24 magnetic beads (3 mm) using only as stone basket and grasping forceps. This prompted one surgeon (MCC) to design a magnetic retrieval device incorporating the Bucky balls that the family gave to him at the time of their post-op visit. The Bucky balls were placed in the lumen of a 14F straight catheter. Our third patient also did have successful endoscopic removal of 28 Bucky balls (4 mm) in a procedure that lasted for 2.5 h using this self-made device. This patient had magnetic debris in his bladder due to long-standing magnets that had disintegrated but also had formed a calcified shell around them. Zhang at al. [10] presented a singular report of the use of a self-made magnetic sheath in 2016 in adult patient who had inserted more than 100 small magnetic beads into his urethra, presumably for autoerotic purposes. The authors describe the use of a sheath which allowed for an expeditious operation taking only 5 minu and removing 5 to 15 beads simultaneously. We found only 1 other pediatric case in which the magnets had degraded over time in the bladder reported by Chung at all in 2014 [11]. These authors report the creation of a 1.5 cm penoscrotal urethrotomy which was made over the foreign bodies, allowing removal in chunks with Hartman ear forceps. By comparison, our magnetic retrieval device was inserted through the urethral meatus that had required a meatotomy.

Noteworthy is the prevalence of behavioral health concerns such as ADHD and Asperger's syndrome in our patients and those that have been previously described in the literature. Sixty-seven percent (6/9) of the patients have either ADHD or Asperger's syndrome [7]. Although the numbers are small, this is certainly suggestive that this population may be more prone to inserting objects such as Bucky balls into their urethra. In addition, 2 of our patients were treated during the COVID-19 pandemic which in and of itself has been shown to heightened stress in pediatric patients. This pandemic has resulted in house confinement of pediatric patients with a greater impact on adolescence. Data supports increased uncertainty, anxiety and boredom [12] in addition to becoming clingy, attention seeking

and more dependent on parents [13]. The psychological effect on pediatric patients with special needs is noteworthy. Patients with special needs show an increase in behavioral problems and acts of self-harm during COVID-19 pandemic [14,15]. Specifically, children with ADHD struggle with the social and physical restrictions, which heighten their hyperactivity and impulses making it difficult to engage in meaningful activities [16].

In summary, an adolescent boy presenting with dysuria and/or hematuria and a urinary tract infection who has an underlying history of ADHD or autism spectrum disorder may warrant consideration of performing a KUB to rule out the presence of a foreign body. These adolescences may not be forthcoming with their prior activity until confronted with a KUB that shows evidence of a foreign body, particularly Bucky balls. Prompt endoscopic treatment can alleviate the problem and the use of a magnetic retrieval device such as the one described in this article may be a very easy way to retrieve these rare earth neodymium magnets and prevent an open cystotomy.

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