



# Postural therapy for renal stones in children: A Rolling Stones procedure

A. Faure <sup>a,b</sup>, E. Dicrocco <sup>c</sup>, G. Hery <sup>b</sup>, R. Boissier <sup>c</sup>, L. Bienvenu <sup>d</sup>, S. Thirakul <sup>d</sup>, P. Maffei <sup>d</sup>, N. Panait <sup>a</sup>, G. Karsenty <sup>c</sup>, T. Merrot <sup>a</sup>, P. Alessandrini <sup>a</sup>, J.-M. Guys <sup>b</sup>, E. Lechevallier <sup>c</sup>

<sup>a</sup>Paediatric Surgery Department, Aix-Marseille Université, APHM, CHU Hôpital Nord, Marseille, France

<sup>b</sup>Paediatric Surgery Department, Aix-Marseille Université, APHM, CHU Hôpital La Timone, Marseille, France

<sup>c</sup>Urology Department, Aix-Marseille Université, APHM, CHU Hôpital La Conception, Marseille, France

<sup>d</sup>Physical Therapy and Rehabilitation Department, Aix-Marseille Université, APHM, CHU Hôpital La Conception, Marseille, France

correspondence to: A. Faure, Department of Paediatric Surgery, Hospital NORD, APHM, Aix-Marseille University, Chemin des Bourrelly, 13015 Marseille, France, Tel.: +33 4 91 96 86 36; fax: +33 4 91 96 86 38

[alice.faure@ap-hm.fr](mailto:alice.faure@ap-hm.fr) (A. Faure)

**Keywords**  
Children; Urolithiasis; Percussion; Kidney

**Abbreviations**  
LCSlower caliceal stones; PDIpercussion, diuresis and inversion; SWLshock wave lithotripsy; URSflexible ureteroscopy; USultrasound

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## Summary

### Introduction

Despite many advances, the management of renal stones – especially lower caliceal stones (LCS) – remains a challenge. The gravity-dependent location of the lower calices hinders the spontaneous clearance of fragments, which can be a nidus for future growth and symptomatic recurrence. Currently, there is no standard adjunctive therapy to facilitate fragment passage.

### Objectives

To report the safety and effectiveness of mechanical percussion diuresis and inversion (PDI) therapy for eliminating renal stones in children.

### Patients and Methods

Since November 2013, children with residual fragments (after shock wave lithotripsy or flexible ureteroscopy) or native symptomatic renal stones were prospectively included in a protocol of four PDI sessions. After giving written consent, the children drank 10 ml/kg of water 30 min before therapy. They then laid in a prone Trendelenburg position on a couch angled at 45° and received continuous 10-min mechanical percussion applied over the affected flank by a physiotherapist (Figure summary). Tolerance stone burden reduction and stone clearance were documented with ultrasound 4 weeks after the last session.

## Results

Seventeen participants, with a median age of 10.8 years (range 18 months to 18 years), received 82 PDI sessions performed over 22 months. The median stone diameter was 5 mm (range 3–9). All children tolerated the PDI therapy well. Over a median follow-up of 11 months (range 3–18), no significant adverse effects were noted. The overall stone-free rate was 65%. Four of the six patients with residual fragment passed their fragments. The patients who did not become stone free by PDI experienced a decrease in fragment size of 57% (range 34–71). The observance rate was 100%.

## Discussion

Many studies have demonstrated that the gravity-dependent position of the lower calyces appears to be an important factor limiting the clearance of LCS. Positioning patients with a degree of inversion in order to put the collecting system beyond the horizontal plane affected the LCS through gravitational force. Complications were rare. PDI appeared to save costs and have similar success rates as shock wave lithotripsy for native small renal stones in children.

## Conclusion

PDI is safe and effective for facilitating gravity-dependent drainage of renal stones and provides an opportunity to treat children in a quick, non-invasive, economic, painless, non-radiative and diverting fashion. This therapy is a valuable alternative in the pattern of stone management. In case of persistent fragments, it is recommend that the number of sessions be increased to six.



**Figure** Adolescent girl receiving mechanical percussion and inversion treatment.

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## Introduction

While renal stones are relatively uncommon in children, in recent years, the incidence has increased. Because children are considered to be at high risk of recurrent stone formation and undergoing multiple stone removal procedures throughout the course of their lives, it is of the utmost importance to render these children stone free [1,2].

The standard procedures with which to treat symptomatic small renal stones in children include shock wave lithotripsy (SWL), flexible ureteroscopy (URS) and – in select cases with anatomical malformations – open surgery [3]. Regardless of the radiation exposure and concerns about anaesthesia, these different therapeutic solutions provide excellent stone-free rates with few complications [3,4]. Residual lower caliceal fragments measuring <5 mm, however, are common [5,6]. In reviewing a series of 500 children who underwent SLW, Badawy et al. found that stones located in the lower calices were less likely to be cleared from the collecting system than stones treated in other areas of the kidney [7]. The gravity-dependent location of the lower calyx hinders the spontaneous clearance of fragments, which can be a nidus for future growth and symptomatic recurrence.

The management of native or residual fragments (after SWL or URS) in the lower calyx remains a challenge. Currently, there is no standard adjunctive therapy to facilitate fragment passage.

Twenty-five years ago, inversion therapy to facilitate gravity-dependent clearance of lower caliceal stones (LCS) was described [8,9]. Since then, several studies have demonstrated that percussion, diuresis and inversion (PDI) therapy may be beneficial for patients with residual stones after SWL. To date, no paediatric studies have been conducted to determine the effectiveness of PDI for eliminating renal stones.

The present study assessed the safety and effectiveness of percussion (quivering the affected flank with a percussor), diuresis (increasing urine flow), and inversion (placing the child at an inverted angle) therapy for treating renal stones and, especially, LCS in children.

## Methods

Since November 2013, patients with residual fragments (after SWL or URS) or with native symptomatic renal stones (stones that cause symptoms but haven't undergone any active treatment) were prospectively included in a protocol of four PDI sessions. The patients selected for the study were children aged <18 years old with renal stones <10 mm in diameter detected by ultrasound (US) or on plain film. Patients were excluded from the study if they had: (a) anatomical anomalies (e.g. UPJ obstruction, ureteral stricture, horseshoe kidney or fragments in a caliceal diverticulum); (b) ureteral stents in situ; or (c) medical conditions causing an inability to tolerate inversion from 30° (e.g. symptomatic gastroesophageal reflux disease, hiatus hernia or a history of cardiac, renal or respiratory failure). Written consent was obtained from all subjects and their parents.

The protocol was approved by the local research ethics committees and performed according to the Declaration of Helsinki.

## Percussion, diuresis and inversion protocol

Before the initiation of therapy, the location and size of the stone were documented with US or plain abdominal radiography. In each PDI session, the patient drank 10 ml/kg of water 30 min before therapy. The patient was then laid in a prone Trendelenburg position on a couch angled at 45° and received continuous mechanical percussion (30 Hz) applied over the affected flank for 10 min by a physiotherapist (Fig. 1). Flank percussion was performed using a mechanical chest percussor (G5®VIBRACARE®, VBC-FR, Physiotherapie générale France S.A, Casteljaloux, France) that is similar to the percussor used for chest physiotherapy in patients with cystic fibrosis (Fig. 2). After each PDI session, the patient was observed for 15 min before discharge. Patients were instructed to consult the therapist if they felt unwell following a session and to strain their urine for fragments for 1 week. No medical expulsive therapy to promote passage of the stone was used.

## Patient data

The collected data included the patient's sex and age, the location and size of the stone, the presence of symptoms, whether there was a concurrent SWL or URS procedure, the underlying metabolic abnormality, complications after PDI, duration of follow-up and outcomes.

Renal stone clearance was defined as no visible stone by US 4 weeks after the last PDI session. A reduction in stone size was calculated as the difference in the diameter of the stone before and after PDI therapy. No US was performed during treatment, except in cases of suspicion of complications.

## Results

During a 22-month study period, 17 participants, with a median age of 10.8 years (range 18 months to 18 years), received 82 PDI sessions. No patient was excluded or declined entry into the study. The characteristics of the patients and their stones are summarised in Table 1. Children who required PDI for residual stones were older than the group with native symptomatic renal stones. Stones were recurrent in three patients and primary in 14. The stone diameter was similar in both groups. Thirteen children had stones in the lower calyx and four had stones in the middle calyx. Four children had bilateral stones. Eleven children who experienced symptomatic episodes required PDI as the first management step. Six children had residual renal stones measuring 5 mm (range 3–6) after SWL ( $n = 5$ ) and URS ( $n = 1$ ). The location of the stone (neither in the lower calyx nor in the middle calyx) and the stone composition were not predictive of success.

None of the children terminated a PDI session before completing the 10 min of percussion. No pain relief medication or sedation was required during patient treatment. Over a median follow-up of 11 months (range 3–18), no

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