LOWER POLE STONE

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The appropriate treatment of lower pole calculi is controversial:

- Shock wave lithotripsy
- Retrograde ureteroscopy
- Percutaneous lithotripsy
The factors which may need to be considered for the treatment of lower pole stone:

- Size of the stone
- Composition of the stone
  - Uric acid/ calcium oxalate dihydrate vs cystine/ calcium oxalate monohydrate
- Intrarenal anatomy
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- Intrarenal anatomy:
  - Infundibulopelvic angle
  - Infundibulum width
  - Infundibulum length
  - Pelvic calyceal height
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- Measurement of lower pole anatomy:
  - Infundibular length: A – B
  - Infundibular width: C – D
  - Infundibulopelvic angle: QRS

Lower Pole Study Group, Albala et al, J Urol 2001
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- Lower infundibulopelvic angle was drawn between central axis of lower pole infundibulum and tangential line at renal pelvis
- Described by Sampaio and Aragao
  - J Urol 1992
 Lower infundibulopelvic angle was determined as angle between central axis of lower infundibulum (not axis of stone bearing calix) and renal pelvis axis (line connecting central axis of upper ureter at lower pole level to central axis of ureteropelvic junction.  

Sampaio et al, J Endourol 1997
LOWE POLE STONE

- Infundibulo-ereteropelvic angle (IUPA-alpha):
  - Angle between central infundibular axis (IA) and perpendicular ureteral axis (UA)

- Bagley and Rittenberg (surg Endosc 1987)
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- **Infundibuloureteropelvic angle (IUPA):**
  - Angle between central infundibular axis (IA) and ureteropelvic axis (UPA)-line connecting central point of pelvis opposite sup and inf renal sinus margin to central point of ureter opposite lower kidney pole

Elbahnasy et al, J Urol 1998
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Caliceal pelvic height
1 is greater than 2
Management of calyceal calculi

Algorithm for management of calyceal calculi ≤15 mm in diameter

AUA update 2001
Shock wave lithotripsy is the initial treatment of choice for most symptomatic renal calculi due to:

- Non-invasive in nature
- Minimal anesthesia requirements
- High level of patient and physician acceptance

Not uniformly successful for all types of kidney stones (lower pole stone).
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  - metaanalysis showed that SFR for ESWL
    - Lower Pole was 60%
    - Upper & middle calyx were 70 to 90%
- Stone Free Rate also related to stone size:
  - 74% for < 10 mm stone;
  - 56% for 11 to 12 mm stone
  - 33% for >20mm stone
- Efficacy of PCNL independent of stone size (SFR 90%)

J Urol 1994
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- The reason for lower clearance rate for lower pole stone after SWL are unclear.
  - The gravity dependent position of the lower pole calix precludes efficient stone discharge

- Various intervention has been suggested:
  - Controlled inversion therapy
  - Mechanical percussion and inversion
  - Irrigation through nephrostomy or via retrograde cobra catheter
Pace et al (2000) - Urology:

- Propective, double blind control trial
- Mechanical percussion, inversion to a 60 degree head down and diuresis weekly with furosamide for 3/52
- 40% stone free in treatment arm as compare to 3% in the observation group.
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- Clearance of lower pole stone fragment after ESWL may be influence by the lower pole collecting system anatomy.
  - 1st suggested by Sampaio and Aragao (J Endourology 1994)
- Using endocasts from cadaveric kidney
  - Angle between the lower pole infundibulum and renal pelvis.
  - The diameter of the lower pole infundibulum
  - The spatial distribution of the calices
They suggested:

1. Lower pole infundibulopelvic angle < 90°.
2. Lower pole infundibulum diameter less than 4 mm.
3. Multiple lower pole calices.

DECREASE LOWER POLE STONE CLEARANCE
Sampaio et al (1997):

- Prospective trial
- 39/52 (72%) patients became stone free when lower pole infundibulopelvic angle < 90°.
- 5/22 (23%) patients were stone free when the angle was less than 90°.
Keeley et al (1999):

- 116 patients who underwent SWL for lower pole stone
- The lower pole infundibulopelvic angle was the only factor significantly predicting stone free status.
  - $< 100^0$ : 34% stone free rate
  - $> 100^0$ : 66% stone free rate
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  - Acute angle (< 100 degree)
  - Distorted calix
  - Narrow infundibulum (< 5 mm)

  - Positive: 9%
  - Negative: 71%

Eur Urol, 36, 1999
- Retrospective study of 159 patients.
- Difference method in measuring infundibulopelvic angle (preop IVP):
  - The measure between ureteropelvic axis (the central point of the renal pelvis and center point of the proximal ureter) and the central axis of lower pole infundibulum.

- Infundibulopelvic angle (70 degree)
- Infundibulum width (5 mm)
- Infundibulum length (3 cm)*

100%

16%*

* 5% of all patients
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  - 88 patients with lower pole stone treated by ESWL.
  - Confirmed the significant of infundibulopelvic angle and width) but the infundibulum length was not statistically significant.
  - 73% clearance with infundibulopelvic angle > 45°

J Urol, 163 (2000)
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  - No significant of all 3 factors.

- Lower pole study Group:
  - Prospective randomised 128 patients
  - No significant of all 3 factors
Lower Pole study Group:

- **PCNL**
  - 128 patients
  - 60 patients (58 treated, 2 awaiting)
  - 95% Stone free rate

- **ESWL**
  - 68 patients (64 treated, 4 awaiting)
  - 37% stone free rate (Related to stone burden)

* 3/12 follow-up for 88% of patients
## Lower Pole study Group:

<table>
<thead>
<tr>
<th></th>
<th>17 stone free</th>
<th>21 residual fragment</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stone size</strong></td>
<td>9.9 ± 1.1 mm</td>
<td>18.8 ± 1.1 mm</td>
<td>P = 0.003</td>
</tr>
<tr>
<td><strong>Infundibular length</strong></td>
<td>31.6 ± 0.2 mm</td>
<td>30.6 ± 0.1 mm</td>
<td>P not significant</td>
</tr>
<tr>
<td><strong>Infundubular width</strong></td>
<td>6.4 ± 0.1 mm</td>
<td>5.8 ± 0.1 mm</td>
<td>P not significant</td>
</tr>
<tr>
<td><strong>Infundibulopelvic angle</strong></td>
<td>45.6 ± 4.1</td>
<td>49.7 ± 3.4</td>
<td>P not significant</td>
</tr>
</tbody>
</table>
Shaw et al (2004, BJU international):
- Evaluate the predictor of success when treating lower pole stone with ESWL specifically pelvi-calyceal height.
- 52 patients with solitary lower calyceal calculi less than 20 mm.
- 28 pts (54%) had successful treatment with 24 pts (46%) had incomplete stone clearance.
**LOWER POLE STONE**

- **Shaw et al (2004, BJU international):**
  - If pelvi-calyceal height $\leq 2$ cm
    - 75% success rate
  - Stone size:
    - $< 1.5$ cm: 85% success rate
    - $< 1.0$ cm: 92% success rate
Innovation in endoscopes and endoscopic lithotrites (holmium laser) has allowed treatment of complex stone burden. 

- Smaller diameter
- Actively deflectable and flexible
- 200 μ holmium laser fiber

Significantly less invasive as compared to PCNL
Grasso et al (1999):
- 79 patients
- Success depend on stone burden:
  - 1-10 mm : 94%
  - 11-20 mm : 95%
  - > 20 mm : 45%
- Factors influence outcome:
  - Long lower pole infundibulum (> 3 cm)
  - Infundibular stricture
- Disadvantage is longer duration of procedure.
Propose algorithm

Lower pole stone

- > 20 mm
  - PCNL

- < 10 mm
  - ESWL

- 11-20 mm
  - favorable
    - ESWL
  - Not favorable
    - RIRS