

procedure is effective with a 90% SFR and efficacy quotient. The study also focused on the factors affecting the complication rates. The authors found that, although operating time, age, institutional experience, orifice dilation, stenting and stone burden were significant on univariate analysis, multivariate analysis revealed that operating time was the only significant parameter affecting the complication rate [1056]. However, for proximal ureteral stones semi-rigid ureteroscopy is not a good first option because of higher complication and failure rates [1060].

A literature review contains a growing number of case series on the use of flexible ureterorenoscopic interventions in children. Both intrarenal and ureteric stones can be treated using this approach [1061-1066]. In these series, the authors generally did not use active orifice dilation, but attempted to use a ureteral sheath where possible. However, an important problem was the inability to obtain retrograde access to the ureter in approximately half of the cases [1062, 1064]. This problem can be overcome by stenting and leaving the stent indwelling for passive dilation of the orifice, and performing the procedure in a second session. The success rates varied between 60-100%, with a negligible number of complications [1061, 1063-1065, 1067]. The need for additional procedures was related to stone size [1065]. Radiation exposure during URS can be minimised by using Flat Panel Detector c-Arms while simultaneously improving image quality [1068].

One RCT and four other comparative studies showed that RIRS had similar stone-free rates compared to SWL after three months, with fewer sessions [1011, 1069-1072]. However for stones larger than 20 mm, RIRS monotherapy has lower stone-free rates than mini-PCNL with the advantages of decreased radiation exposure, fewer complications and shorter hospital stay [1073]. In contrast, for stones between 10-20 mm, RIRS has similar success and complication rates and shorter hospital stay and low radiation exposure when compared to micro-PCNL [1074]. A recent systematic review revealed that compared with the other two treatments, PCNL had a longer operative time, fluoroscopy time and hospital stay. Shockwave lithotripsy had a shorter hospital stay, higher retreatment rate and auxiliary rate in comparison with the other two treatments. It was also shown that PCNL presented a higher efficacy quotient than the other two treatments, and RIRS had a lower efficiency than SWL and PCNL. In the subgroup analysis of paediatric patients with stone $\leq$ 20 mm, the comparative results were similar to those described above, except for the higher complication rate of PCNL than SWL [1075].

3.16.4.4 *Open or laparoscopic stone surgery*

Most stones in children can be managed by SWL and endoscopic techniques. However, in some situations, open surgery is inevitable. Good candidates for open stone surgery include very young children with large stones and/or a congenitally obstructed system, which also requires surgical correction. Open surgery is also necessary in children with severe orthopaedic deformities that limit positioning for endoscopic procedures.

In centres with well-established experience, a laparoscopic approach may be a good alternative for some cases as a last resort before open surgery. Suitable candidates include patients who have a history of previously failed endoscopic procedures, complex renal anatomy (ectopic or retrorenal colon), concomitant UPJ obstruction or caliceal diverticula, mega-ureter, or large impacted stones. Laparoscopic stone surgery via conventional or a robot-assisted transperitoneal or retroperitoneal approach can be attempted. However, there is limited experience with these techniques and they are not routine therapeutic modalities [1076-1079].

Bladder stones in children can usually be managed by endoscopic techniques. A recent randomised trial compared transurethral cystolithotripsy versus percutaneous cystolithotripsy for bladder stones smaller than 30 mm and found similar success and complication rates with success rates more than 95% [1080]. Open surgery may also be used for very large bladder stones or for bladder stones caused by an anatomical problem.

In addition to the advantages and disadvantages of each treatment modality for the specific size and location of the stone, consideration has to be given to the availability of the instruments and the experience with each treatment modality before the choice of technique is made. Recommendations for interventional management are given in Table 4.