Decreasing Cost of Flexible Ureterorenoscopy: Single-use Laser Fiber Cost Analysis

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OBJECTIVE
To demonstrate a cost benefit while using disposable laser fibers as compared with reusable laser fibers. Flexible ureteroscopy (FURS) is a central component of endourology. It is vital that for service provision and training purposes, costs are kept down while delivering this service. Laser fibers are known to damage scopes causing high repair and/or replacement costs.

MATERIALS AND METHODS
Data for consecutive FURS procedures during 2 periods in a single center were compared. First, with the use of reusable fibers and second, with single-use fibers. Cost of laser fibers and repairs was recorded. The study excludes the cost of the initial purchase of the ureterorenoscopes or the holmium laser equipment and costs associated with staffing and hospital stay.

RESULTS
The total number of FURS carried out in period 1 and period 2 was 260 and 265, respectively. A total of 13 reusable (185 procedures) and 168 disposable laser fibers were used in these 2 periods, respectively. There was a reduction in laser damaged ureteroscopes from 9 to 3 in the second period. This resulted in a £16,800 reduction in repair cost. This more than offsets the increased costs of single-use fibers.

CONCLUSION
On the basis of our data, it is more cost-effective to use a disposable laser fiber, as it prevents scope damage, which can happen because of microfractures with repeated laser use. Moreover, this will also save time and/or resource required with sterilization.

In light of the growing applications for FURS, it is essential that this specialist equipment is maintained to provide patients with optimal treatment and allow training of such a demanding technique. Flexible ureterorenoscopes are fragile and their durability is variable, with a significant user and manufacturer variability. Knubsen reported major repairs after <10 uses, whereas Traxer et al reported 50 consecutive uses from a single ureteroscope. Thermal laser damage to the working channel is the most common cause of scopes’ failures.

Flexible ureterorenoscopy (FURS) is an increasingly important part of the armory of modern urology departments. Marshall reported the first ureteroscopy with 9F fiberoptic scope (no active deflection) inserted through ureterotomy in 1964. Since this time, the diameter of the ureteroscopes has reduced while maintaining an adequate working channel caliber, the degree of deflection has significantly increased to 270°, and optical resolution has dramatically improved. All these advances have resulted in the FURS being used for increasingly broad applications. Laser lithotripsy remains the most common procedure, with now increasingly large stones (>2 cm) being dealt with. FURS allows nephron-sparing management of upper urinary tract urothelial cell cancer for those who would not be suitable for radical treatment in providing potentially curative treatment option. Endopyelotomy, endoureterotomy, and evaluation of upper urinary tract are but a few of the additional potential uses of flexible ureterorenoscope.

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basic cost of FURS was £120 plus the cost of any accessories. This was calculated by dividing the total repair cost for the year (£31,300) by the total number of procedures (260). During this 12-month period, in which laser was required, a multiuse fiber was applied. Subsequently, the department has introduced the more expensive single-use laser fibers, on the basis of convenience, consistency of energy transfer, safety, and potential reduction in laser-induced damage of flexible ureterorenoscopes. It was noted subjectively that after this change, there was a significant reduction in the frequency of scope repair.

The aim of this audit was to establish whether there was a reduction in repair costs secondary to laser damaged during a further 12-month period and whether this offsets the additional cost of using single-use laser fibers.

**MATERIALS AND METHODS**

All FURS procedures between period 1 (March 2009-March 2010) and period 2 (March 2011-March 2012) were reviewed. The types of procedures were recorded, and the total repair costs were calculated. Bilateral cases were counted as 2 procedures. For each FURS requiring repair, Karl Storz routinely provided the technical report, and the cause of damage was documented. Frequency of laser damage and cost of repair from period 1 to period 2 with the use of single-use laser fibers. Laser-related repair costs during period 1 and 2 were therefore £25,500 and £8500, respectively.

During period 1, 4 reusable 365-μm fibers (£550 each) and 8 reusable 200-μm fibers (£1265 each) were used during 185 procedures. Cost of sterilization of a laser fiber was £8 per case. The total cost for this, therefore, including sterilization was £13,800. During period 2, 168 single-use 273-μm fibers were used (£160 each). The total cost was £26,880. Hence, the total sum of repair cost and laser fiber cost, including sterilization for period 1 was £45,100 (£31,300 + £12,320 + £1480), and the sum of repair cost and laser fiber cost for period 2 was £44,805 (£17,925 + £26,880).

Although, in period 2 with the use of disposable laser fiber, approximately additional £13,000 was spent on the cost of laser fibers, there was a £16,800 reduction in laser-specific ureteroscope repair cost and a saving on sterilization of laser fiber (approximately £1500).

**RESULTS**

During period 1, there were 260 FURS procedures (Table 1). The repair cost during this year was £31,300 (Table 2). This covered 11 major repairs and 1 minor repair. During period 2, there were 265 FURS procedures (Table 1). The repair cost during this period was £17,925 (Table 2). This covered 6 major repairs and 3 minor repairs.

The technical reports for period 1 showed that 9 ureterorenoscopes requiring major repair had laser damage. The technical reports for period 2 showed that 3 scopes had laser damage. The relative risk reduction of laser-related FURS damage was 0.37 (P = .13) from period 1 to period 2 with the use of single-use laser fibers. Laser-related repair costs during period 1 and 2 were therefore £25,500 and £8500, respectively.

<table>
<thead>
<tr>
<th>Time Period</th>
<th>Fiber Type</th>
<th>Total Cases</th>
<th>Total Procedures</th>
<th>Diagnostic Procedures</th>
<th>FURSL Procedures</th>
<th>Bilateral Procedures</th>
<th>Laser Ablation Procedures</th>
<th>Other Procedures</th>
<th>Laser Used</th>
<th>Fiber Cost</th>
<th>Laser Use</th>
<th>Cost of Fibers and Processing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Period 1</td>
<td>Multiple use</td>
<td>226</td>
<td>260</td>
<td>41</td>
<td>129</td>
<td>34</td>
<td>19</td>
<td>9</td>
<td>3</td>
<td>1265 each</td>
<td>550/each</td>
<td>£2200 + 480</td>
</tr>
<tr>
<td>Period 2</td>
<td>Single use</td>
<td>225</td>
<td>265</td>
<td>58</td>
<td>120</td>
<td>19</td>
<td>9</td>
<td>40</td>
<td>3</td>
<td>160 each</td>
<td>160/each</td>
<td>£2200 + 480</td>
</tr>
</tbody>
</table>

**COMMENT**

Our review shows that in a well-matched sample, there was a reduction in damage to flexible ureterorenoscopes with the use of disposable laser fibers. In the first period, there were 9 laser damage scopes, which reduced to only 3 scopes in the second period. These procedures were done by an experienced surgeon (G.S.K.) either directly or supervising a trainee. All scopes used in both periods were Storz Flex X2. The strength of our study is the ability to do direct comparison between the 2 periods in which the cost of repairs remained stable and all damaged scopes were replaced with a new scope.

Single-use laser fiber shows consistent performance in energy transmission and fracture resistance. Fiber failure is correlated with the total energy delivered during ureteroscopy.12 Although different laser fibers have different performance characteristics in terms of energy transmission and fiber burn back, this can be reduced by fiber selection or the use of low pulse energy.13 Reusable fibers have to be cleaved, jacket of the fiber stripped, and fiber then sterilized for the next use and hence can be damaged.
in any of these processes. Although a previous study mentions reusable holmium:YAG laser fibers as more cost effective, they fail to mention cost of repairs from laser damage. The risk of fiber fracture and thermal damage is most during a bent scope such as during lower pole stone fragmentation.

Although not a randomized study, consecutive FURS done in 2 periods have been compared. The number of procedures in these two 12-month periods was similar and with comparable case-mix being done by the same team. The surgeon (G.S.K.) was already very experienced, and this should not have biased the scope repairs in the second period. The trainees involved will not have been involved in both periods because of the rotational nature of the training program. In addition, the trend in our unit has been to manage larger and more complex stones ureteroscopically and, therefore, one would expect more laser damage during period 2, which was not the case, highlighting further the case of using disposable fibers. Also, the nonlaser damage in both groups was equal—again suggesting there is not a distinct difference in the handling skills of the operator.

There appears to be an increased risk of laser damage to flexible ureterorenoscope when using reusable fibers. This is likely to be because of microfracture and energy leakage around the point of articulation during scope deflection over multiple cases. Our department is currently conducting a prospective assessment of damaged scopes to clarify the location of the laser damage along the length of the scope. Damage at the distal tip would suggest operator’s misuse, firing laser within the scope; however, more proximal damage would suggest laser fiber energy leakage. Currently, where reusable fibers are used, we would advise that several centimeters are trimmed from the reusable fibers after each use, to avoid microfracturing and energy leakage around the point of articulation.

As larger stones are treated ureteroscopically with good outcomes, it is in the benefit of individual hospitals and surgeons to be aware of laser fiber scope damage to prevent expensive repairs and preserve their scopes. Urology units performing these procedures must audit their results to maximize efficiency and reduce cost-related to these procedures. It is hoped that our findings will help other units in the procurement of equipment and service contracts such as those outlined previously to enable the delivery of excellent and well-maintained endoscopic services.

CONCLUSION

Our results show that although the upfront cost of disposable fibers are higher, this more than offsets the cost of laser fiber damage and scope repairs caused by reusable fibers besides the cost and hassle with resterilization of reusable fibers.

References