Sir,

## A study of slippage of various knot configurations

Penetrating keratoplasty (PK) still remains the predominant procedure in corneal graft surgery. Complications include wound dehiscence, immune-mediated rejection, and refractive errors.[1] A study by Jeganathan *et al*[2] showed that resuturing of corneal wounds after PK may be required for various reasons, including wound dehiscence, loose sutures, and infectious keratitis, which can increase the incidence and severity of complications many fold.[2,3] There is evidence that inflammatory response and adhesion formation surrounding the sutures are most pronounced at the site of the knot.[4,5]

Three different knots, 3/1/1, 1/1/1(slip-knot), and 1/1/1/1(modified slip-knot), were compared using 10-0 black monofilament polyamide-6 suture (Ethilon 30 cm with a 6-mm micro-point spatula needle, Johnson & Johnson, New Brunswick, NJ, USA). A special apparatus was designed for the study (Figure 1). The horizontal and vertical sizes of the knots and slippage were measured with a calibrated eyepiece graticule using a Nikon-E51i binocular bright-field microscope (New York, NY, USA).

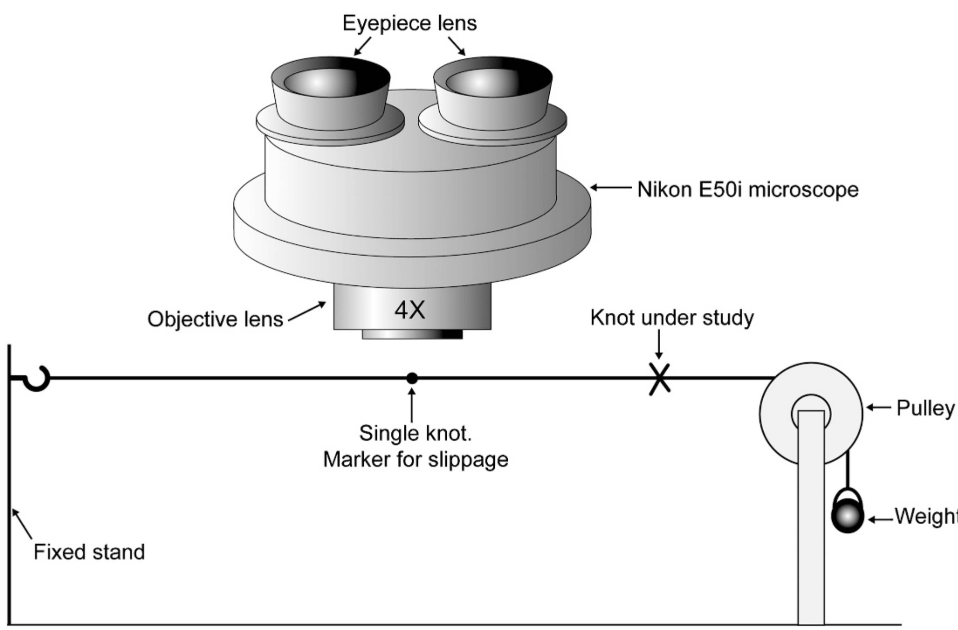


**Figure 1** Schematic diagram of the knot under study.

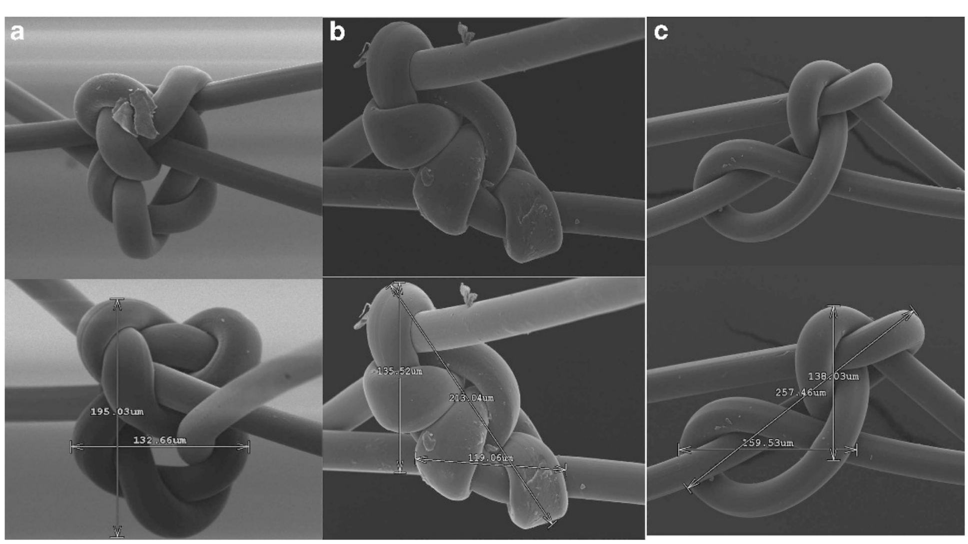


**Figure 2** (a) (Left): Scanning electron microscope image of 3/1/1 knot (100 $\mu$m); (b) (middle): scanning electron microscope of knot 1/1/1/1 (100 $\mu$m); (c) (right): scanning electron microscope image of 1/1/1 (100 $\mu$m).

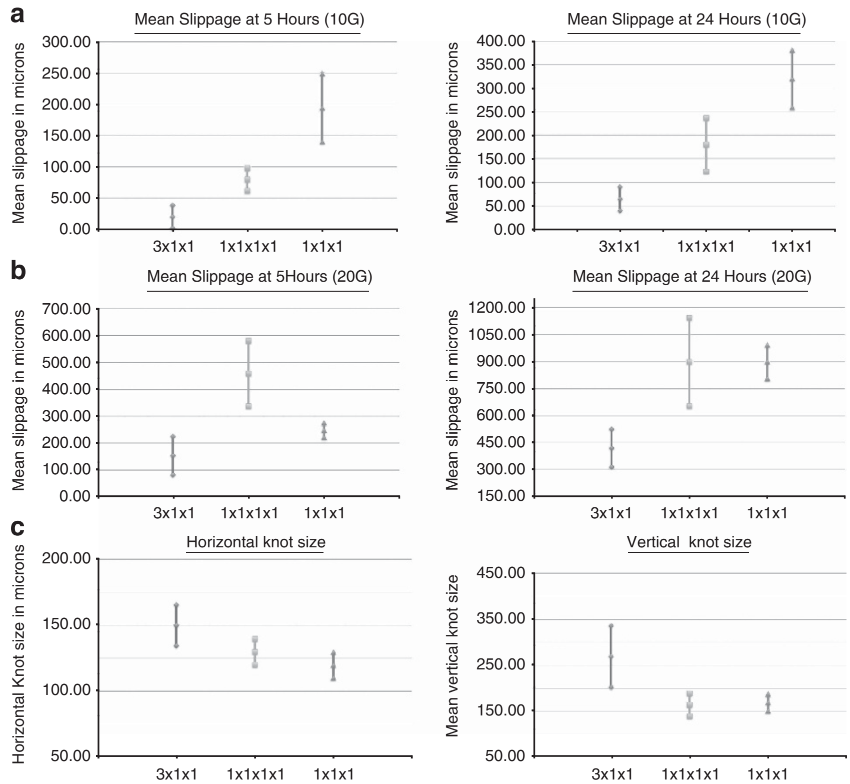


**Figure 3** (a) Knot slippage with 10-g weight (top left: mean slippage at 5 h; top right: mean slippage at 24 h). (b) Knot slippage with 20-g weight (middle left: mean slippage at 5 h; middle right: mean slippage at 24 h). (c) Average knot morphology of the three different types of knots (bottom left: horizontal knot size; bottom right: vertical knot size). (Error bars show ±95% confidence interval (CI))

**Table 1** Statistical values of paired *t* tests used to compare knots

| *Hours* | *Knots compared* | P-*values* |
|---|---|---|
| *20-g Weight* | | |
| At 5 h | 1 × 1 × 1 *vs* 1 × 1 × 1 × 1 | 0.05 |
| | 1 × 1 × 1 *vs* 3 × 1 × 1 | 0.09* |
| | 3 × 1 × 1 *vs* 1 × 1 × 1 × 1 | 0.01 |
| At 24 h | 1 × 1 × 1 *vs* 1 × 1 × 1 × 1 | 1* |
| | 1 × 1 × 1 *vs* 3 × 1 × 1 | 0.003 |
| | 3 × 1 × 1 *vs* 1 × 1 × 1 × 1 | 0.02 |
| *10-g Weight* | | |
| At 5 h | 1 × 1 × 1 *vs* 1 × 1 × 1 × 1 | 0.03 |
| | 1 × 1 × 1 *vs* 3 × 1 × 1 | 0.003 |
| | 3 × 1 × 1 *vs* 1 × 1 × 1 × 1 | 0.009 |
| At 24 h | 1 × 1 × 1 *vs* 1 × 1 × 1 × 1 | 0.05 |
| | 1 × 1 × 1 *vs* 3 × 1 × 1 | 0.002 |
| | 3 × 1 × 1 *vs* 1 × 1 × 1 × 1 | 0.004 |

*Values >0.05 are not statistically significant.

Knot slippage was observed at 5 and 24 h. The study was repeated five times for each knot type. Knot morphology was observed using a scanning electron microscope (Figure 2).

Using a tension weight of 10 g, the mean slippage of knots measured at 5 and 24 h was least with 3/1/1 and maximum with 1/1/1 (Figure 3a). Using a tension weight of 20 g the mean slippage of knots at 5 h was least with 3/1/1 and maximum with 1/1/1/1, while at 24 h it was equal with 1/1/1 and 1/1/1/1 (Figure 3b). The knot size was measured in vertical and horizontal axes to the suture line. The 3/1/1 knot was found to be the largest (Figure 3c). There was no significant difference seen in the size of 1/1/1 and 1/1/1/1 knot.

Paired *t* test was used for statistical analysis (Data analysis toolpak, SPSS, Chicago, CA, USA) (Table 1).

In conclusion, our study demonstrates that 3/1/1 is the most secure knot with least slippage but was the largest of the three knots. The 1/1/1 knot showed the most slippage. The 1/1/1/1 knot may be a better knot type with benefits of minimum slippage and a smaller knot size, making it easy to bury.

## Conflict of interest

The authors declare no conflict of interest.

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M Rana, V Savant and JI Prydal

Department of Ophthalmology, University Hospitals of Leicester NHS Trust, Leicester, UK
E-mail: mrana@me.com

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Sir,

**Response to 'An economic comparison of hospital-based and community-based glaucoma clinics'**

The cost-analysis presented by Sharma *et al*[1] reported that a community model, where patients were monitored by 'accredited' optometrists, was more than double the cost of a hospital-based service. Notwithstanding concern that the community service did not use clinicians with specialist training and a glaucoma qualification awarded by the appropriate professional body as demanded by NICE, the results were surprising to the authors of this reply who are optometrists with a specialist glaucoma qualification and independent prescribing status because we offer private glaucoma services in community at separate locations within the UK at a much lower cost than estimated. We would like to suggest why the model does not agree with reality.

The community model was based on the appointment structure of sight tests that involve refraction, with only 11 patients being seen per day. In contrast, it is typical for optometrists working in hospital glaucoma clinics to have a daily caseload of 20 patients. We have been told by an author of the study that this reflected the inclusion of 'non-stable' cases (Professor Lawrenson, personal communication), but remain unconvinced that such a large reduction in volume is needed. The opportunity cost to optometrists relative to their usual business of providing sight tests and selling spectacles was used as a surrogate for the cost of providing glaucoma services. A wide range of values have been reported for this figure, which is not unexpected given the large variation in overheads and retail income. Recently, in a joint publication by the main optical bodies, it was estimated that the daily cost of running a practice was £910–1225,[2] which is less than the £1601.81 suggested by optometrists involved in this study. The inflated opportunity cost in this study may reflect the relatively high-rental rates and retail income in London, but their disagreement with other reports indicates that they may not be applicable to other regions. If the community costs suggested by the main optical bodies and the typical daily caseload of 20 patients are used, we have a cost per visit of £45.50–61.25, which is much less than the £145.62 reported.

Insufficient details were given in the paper to allow for an opinion on the validity of cost estimates of the hospital-based glaucoma service, but of more relevance is the fact that hospital services in the UK use a fixed tariff system and so from the view of the funding body no estimate is needed. The 2010/2011 outpatient attendance allowance for ophthalmology was £67 for follow-up attendance (WF01A) and the market forces factor for Ealing Hospital NHS Trust was 1.197, and so we calculate that the real cost per visit to the funding body was £80.18.[3] We doubt that hospitals are prepared to work for less than this opportunity cost.

## Comment

The discrepancy between the study results and our experiences shows that the cost of a particular model of community-based glaucoma services cannot be generalized to all community-based glaucoma services. It is also important to appreciate that optometrists working in community can improve accessibility and increase capacity of glaucoma services, which is relevant in the context of the typically elderly glaucoma population and increasing appointment delays that have already led to avoidable sight loss.

## Conflict of interest

The authors declare no conflict of interest.

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M Johnson[1], A Jones[2] and J Tickner[3]

[1]Bristol Eye Hospital, Bristol, UK
[2]Jones and Jones Optometrists, Barry, UK
[3]Howie and Tickner Optometrists, Highcliffe, UK
E-mail: johnsonmyoptometrist@gmail.com

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