00432 Tying Force Required to Close a Secured Surgical Knot

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Aims: Knowing the optimum force required to tie a secure knot would minimise chances of knot slippage which results in abnormal scarring, pain and infection. The objective of this in vitro study was to investigate the optimum force needed to tie the most secure knot. Cyclic and static biomechanical testing was also compared.

Methodology: Five tying forces 1N, 2N, 3N, 4N, 5N were investigated. The surgeon's knot with 3 throws (2-1-1) was used to suture two 70x15mm porcine skins together with Prolene 4.0. Ten specimens were involved in each group. The specimen was subjected to 2 stages of cyclic testing of 200 cycles. Stage I was subjected to a cyclic load of 2N-10N and Stage II, a cyclic load of 2N-20N. Survival rate of the knots for each stage was calculated. Knots that survived were subjected to static testing. Ultimate tensile strength (UTS) required to cause knot slippage was recorded.

Result: 3N tying force had the highest survival rate of 100% in stage I and 90% in stage II. Another finding was that knots tied with different tying forces behave independently under various cyclic loading conditions. In comparison, 4N tying force had the highest UTS. However, tying a knot with a force greater than 3N did not achieve significantly better results. ($p>0.05$)

Conclusion: This study suggests that 3±0.5N tying force can be the optimum range of force needed to tie a secure surgeon's knot with respect to the suture Prolene 4.0. Cyclic testing should be the method of choice when investigating knot security.