# ABSTRACT

Silk braided sutures with three different structures (Structure A, Structure B and Structure C) are produced using a circular braiding machine. The effect of gauge length, extension rate and braid angle on tenacity and knot strength of silk braided sutures are studied. In all the three structures, silk sutures tested at longer gauge length and lesser test speed showed higher values of tenacity and knot strength. Also, out of all three structures, silk sutures fabricated at lower braid angle 27.1 (Structure C) showed higher values of tenacity and knot strength than the other structures. The effect of normal load, sliding speed and braid angle on the frictional properties of silk braided sutures are studied. In all the three structures, it is observed that there is decrease in the coefficient of friction with the increase in normal load and sliding speed. Also, silk sutures fabricated at lower braid angle 27.1 (Structure C) showed lower value of friction than other structures. The antimicrobial activity of the silk sutures is determined using the Agar Diffusion Method and no zone of inhibition is found against both *E. coli* and *S.aureus* bacteria. This indicates that silk sutures do have poor resistance to bacteria. Hence to impart bacterial resistance characteristics, silk sutures are treated with two types of antimicrobial agents namely tetracycline hydrochloride and chitosan.

Tetracycline hydrochloride (TCH) solution is prepared at five different concentrations. Silk sutures produced at braid angle 27.1(Structure C) is treated with tetracycline hydrochloride solution and the effects of TCH treatment on the suture properties are studied. The result showed that TCH concentration in the selected range has no significant effect on friction, tenacity and knot strength of silk sutures. Antimicrobial test results showed that the TCH treated silk suture exhibits greater antimicrobial activity against *E. coli* than *S.aureus* bacteria. Furthermore, the antimicrobial activity increases with the concentration of the drug. At 1 % concentration of TCH, a zone of inhibition of 32mm and 25mm are observed against *E. coli* and *S.aureus* respectively. The properties of tetracycline hydrochloride treated silk sutures are compared with commercial silk sutures. Tenacity and knot strength of TCH treated silk sutures are comparable to that of commercial silk sutures. Conversely, the coefficient of friction is found to be higher than the commercial silk sutures. However, the in vitro and in vivo antimicrobial activity of TCH treated silk suture is found to be significantly higher than the commercial silk sutures.

Silk suture produced at braid angle 27.1 (Structure C) is also treated with chitosan solution at three different concentration and the effects of chitosan treatment on the suture properties are studied. Silk sutures treated 3 % chitosan concentration showed lowest friction value of 0.2134, whereas untreated silk sutures showed highest friction value of 0.3250. Instron test

results showed that the tenacity and knot strength of silk braided sutures increases with the increase in chitosan concentration. Silk sutures treated with 3 % chitosan concentration showed highest tenacity and knot strength of 39.7 cN/tex and 29.6 cN/tex respectively. The antimicrobial test results showed that the silk braided sutures treated with higher chitosan concentration exhibits excellent antimicrobial activity against both the bacteria. At 3% chitosan concentration, a zone of inhibition of 13mm and 12mm is obtained against *E.coli* and *S.aureus* bacteria respectively. Furthermore at 3% chitosan concentration, 100 % bacterial reduction is obtained against both the bacteria. The properties of commercial silk sutures are compared with chitosan treated silk sutures. It is noted that the chitosan treated silk sutures exhibits higher tenacity, higher knot strength, excellent in vitro and in vivo antimicrobial activity and lower friction value than commercial silk sutures.

In recent years, Poly (L-lactic acid) based absorbable polymers have attracted increasing attention as a candidate for use in suture applications. Poly (L-lactic acid) based polymers can be transformed by spinning into filaments for subsequent fabrication of desirable textile structures. The dry–jet–wet spinning process is employed to spin Poly (L-lactic acid) (PLLA)/ poly (lactide-co-ε-caprolactone) (PLCL) (90/10 %) fibres. The as spun fibres are subsequently subjected to two-step process of drawing and subsequent heat setting. The effect of draw ratio on tenacity and knot strength is studied. The tenacity value increases with increase in

draw ratio and maximum tenacity value of 30cN/tex is achieved at draw ratio 9. The effect of draw ratio on knot strength is similar to that of the tenacity. The maximum knot strength of 22cN/tex for blended fibre is achieved for a draw ratio of 9. The addition of PLCL in PLLA, in order to reduce the glass transition temperature and crystallinity has shown a strong effect on the fibre properties. The PLLA/PLCL fibre with the crystallinity of 40% and glass transition temperature of 58°C are achieved at draw ratio 9. The asspun PLLA/PLCL fibres showed a porous structure throughout the surface, whereas considerable change in the surface morphology is observed in case of drawn fibres.