Design & Development of Curcumin Loaded Zinc Oxide Nanoparticles Decorated Mesoporous Silica Liquid Stitches: A Proof of Concept in Animals

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Background: The present research was aimed to develop an **alternative for sutures, cyanoacrylate adhesives** etc. which are currently used to close the wounds or surgical incisions; As these solutions have a drawback of toxicity and delayed healing. Moreover, the sutures lead to the formation of scar tissue as well as the permanent marks on the skin which is not desirable. The cyanoacrylates produce the local heat and liberates the formaldehyde upon application which leads to damage of tissue. To overcome these problems, we have developed a liquid stitches. The present research was aimed at synthesizing and characterizing curcumin-loaded zinc oxide nanoparticle-decorated mesoporous silica as a tissue adhesive (Liquid Stitches). The mesoporous silica nanoparticles facilitate adhesion to tissues through the nanobridging effect. The curcumin strengthens the antibacterial effect of this novel tissue glue (Liquid stitches), while the zinc oxide nanoparticles enhance the strength of the bonding between two tissues

Methods: The mesoporous silica was synthesized using a sol–gel methodology, and the drug was incorporated using the wetness impregnation method. The platform that was prepared was characterized using infrared spectroscopy, TEM, DSC, XRD, particle size analysis, BET analysis, a tissue model adhesion test, an antimicrobial assay and a wound model in Sprague Dawley rats.

Results: The average particle size was found to be 72.4 nm, while the surface area was found to be 654 m^2/g. The tissue model adhesion graphs showed significantly different values for the peak load, work done and deformation at peak load, which reflects a difference between the glue strengths of the mesoporous silica nanoparticles and the Cur-ZnO-MSN and the carrier medium (water). The animal study provided a proof of concept by gluing wounds in less than 1 minute and healing the wound within 5 days.

Conclusions: The desired pore volume, particle size and surface developed an excellent tissue glue. It facilitated an excellent bond between tissue chains with the help of nanobridging effect which was shown by in-vivo and in-vitro experimentation. It facilitated gluing of skin in less than 1 minute & healed the wound in 5 days & proved itself as an excellent substitute to stitches.