Quick-Release Medical Tape

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Statement of Purpose: In neonates medical tape removal often causes injury because their skin is underdeveloped and fragle. Medical tapes used in the neonatal intesive care unit must secure devices reliably as they perform vital functions, as a result the adhesives must be aggressive and therefore often damage sensitive skin on removal. To address this unmet need, we created quick-release tape that adheres as well as aggressive medical tapes using the same, widely tested adhesives, but can be removed quickly and without damage. Quick-release tape adds a third, middle layer to the standard two-layer tape design. This highly engineered middle layer consists of ordered anti-adhesive and adhesive regions enabling full control over interfacial adhesion between the middle and adhesive layers. Quick-release tape has an anisotropic adhesive interface that adheres well in sheer, yet is readily removed when peeled. Because peeling occurs between the middle and adhesive layers, rather than between the adhesive and the skin, the stress is concentrated away from the skin allowing for rapid, safe removal.

Methods: To create quick-release tape, polyethylene terephthalate (PET) sheets were coated in silicone release liner (Dow Corning). The coated sheets were laser etched (Universal Laser Systems) to expose regions of adhesive PET within the anti-adhesive release liner coated sheets. Mechanical testing was performed on an ADMET mechanical testing system. Ninety degree peel, shear and tack testing was performed in accordance with recommendations by the Pressure Sensitive Tape Council as appropriate. Statistical analysis was performed by one-way ANOVA with Tukey HSD *post hoc* test.

Results: Quick-release tape backings can achieve any peel strength between the PET backing and adhesive (highest adhesion) and anti-adhesive silicone release liner coated backing and adhesive (lowest adhesion) by altering the laser-cutting pattern (Figure 1). The level of peel adhesion correlates well with the percent of PET backing exposed. Provided the adhesive regions are sub-millimeter in width, the backings homogeneously peel from the adhesive layer without removing any adhesive from the underlying substrate.

The adhesive shear strength of a neonatal endotracheal tube the tape remains high (>30N), as with standard medical tapes (25-30N), when quick-release tape is intact. Once the backing is removed from quick-release tape, medical devices (e.g. neonatal endotracheal tubes) are removed from the remaining adhesive with little required force (~1N).

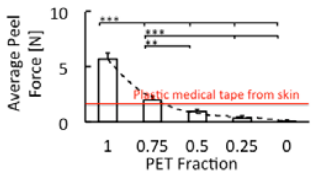

Figure 1. Laser etching exposes adhesive polyethylene terephthalate (PET) regions in silicone release-liner coated sheets to create quick-release tape backings. The average peel force exhibits an inverse cubic relationship with exposed PET fraction.

Due to the anisotropic adhesive properties created by laser-etching adhesive regions into anti-adhesive coated polymer sheets, quick-release tape can be peeled with low force, yet retains high sheer strength for affixing medical devices. Peeling concentrates stress to create a fracture line, while in shear all of the adhesive bonds between the backing and adhesive are stressed at once over a diffuse area enabling the dual adhesive functionality of quick-release tape (pictured in Figure 2).

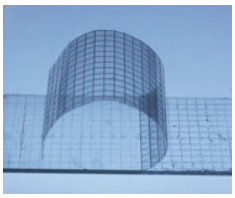

Figure 2. Photograph of quick-release tape. Curled portion is the laser-patterned backing and middle layers. The adhesive remains on the glass slide during peeling with the imprint of the laser-patterned grid lines.

In removing the backing and middle layers from quick-release tape, the adhesive layer remains behind on the skin by design. The residual adhesive can be de-tackified with talcum powder (<0.1N/cm^2). Moreover, talc de-tackified residual adhesive although non-adhesive itself can serve as an attachment point for additional medical tape without any loss of adhesive strength (4N/cm^2).

Conclusions: Quick-release tape is an effective medical tape that adheres as well as standard medical tapes; yet, quick-release tape can be removed without damaging sensitive skin.

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References: Laulicht B, Langer R, Karp JM. Proc Natl Acad Sci USA. 2012;109(46):18803-18808.