

ELECTRONIC SUPPLEMENTARY INFORMATION

A Novel Approach to Measure Needle Insertion Response and
the Overlooked Impact of Insertion on Injection Outcomes

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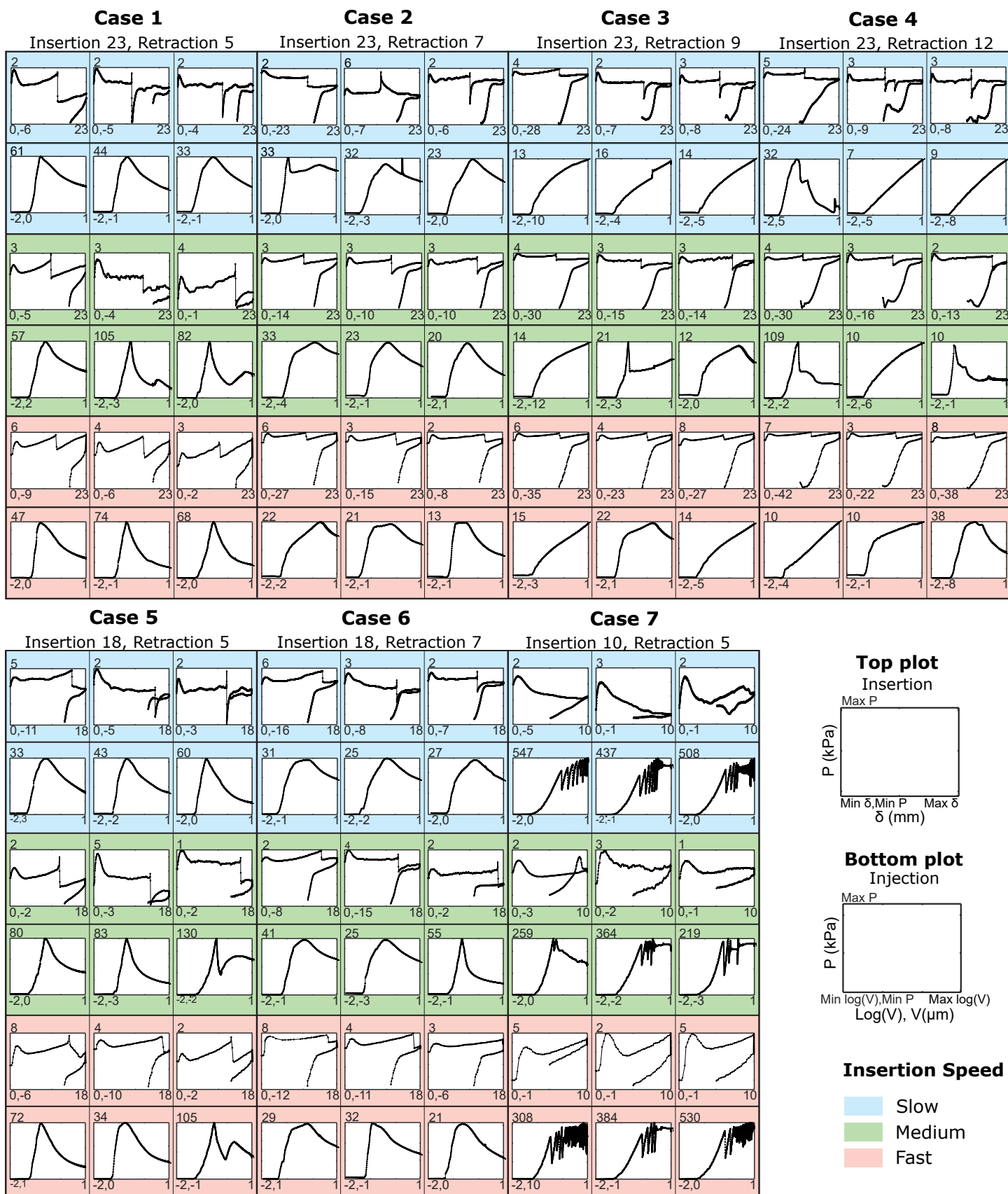


Figure S1: Insertion and injection results for Polydimethylsiloxane (PDMS). In each colored band, each replicate is shown as a paired set of plots: the top plot is insertion (pressure-depth) and the bottom plot is injection (pressure-log(volume)). Three repeats are shown for each case. The blank panels at the lower right define the plot/axis labeling conventions.

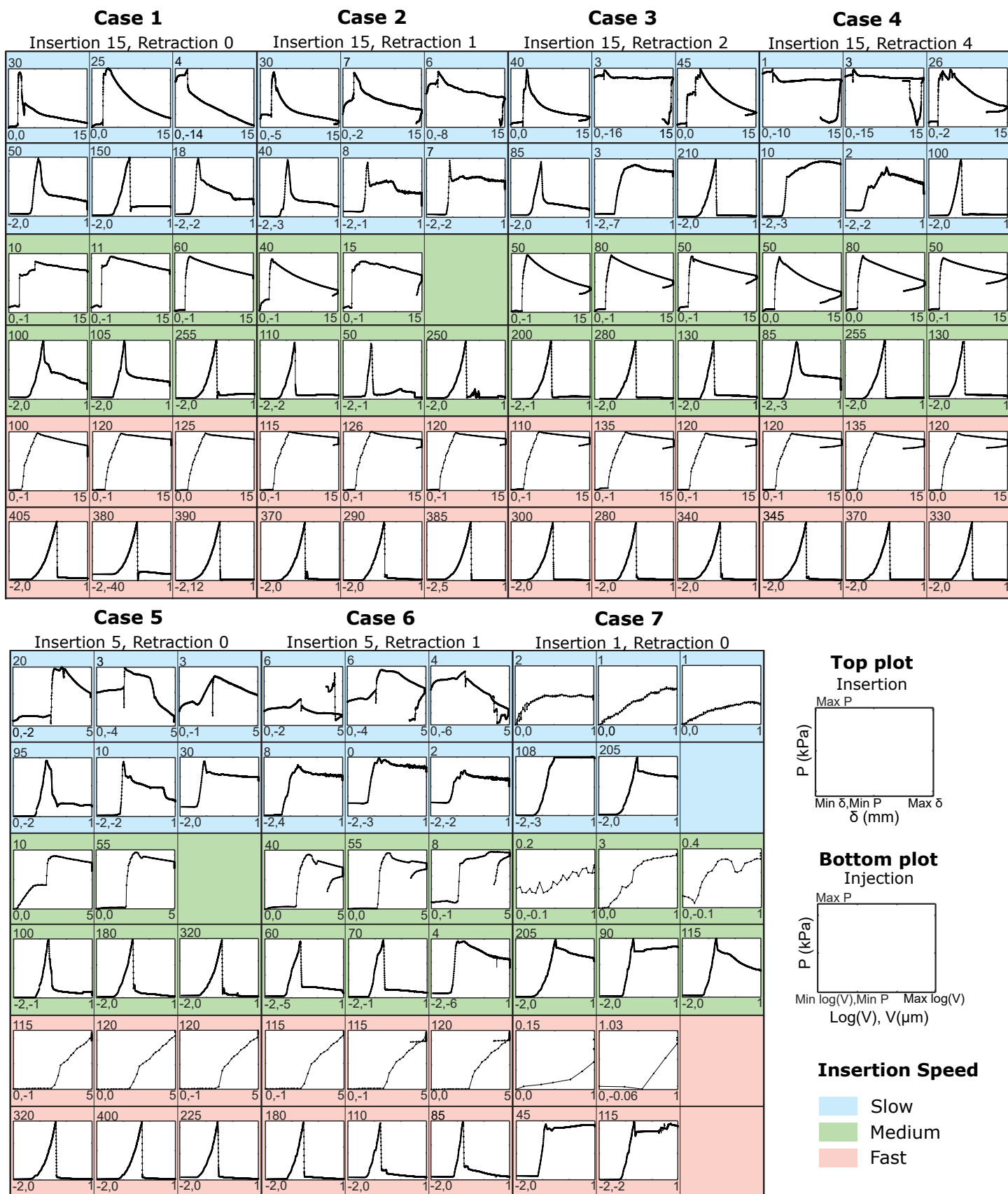


Figure S2: Insertion and injection results for gelatin. In each colored band, each replicate is shown as a paired set of plots: the top plot is insertion (pressure-depth) and the bottom plot is injection (pressure-log(volume)). Three repeats are shown for each case. The blank panels at the lower right define the plot/axis labeling conventions. Empty cells indicate datasets that were not recoverable after the experiment.

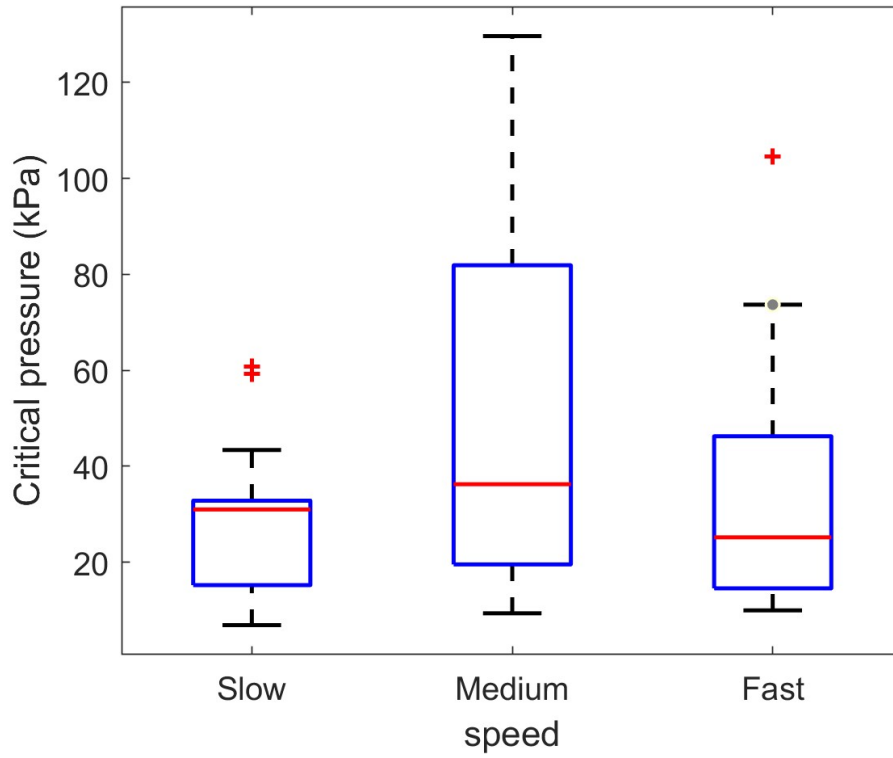


Figure S3: Fluid injection critical pressure variations in PDMS as a function of insertion speed (0.5 mm/s (slow), 2.5 mm/s (medium), and 12.5 mm/s (fast)). Box plots represent the distribution of critical pressure values across all valid tests at each speed. For each box, the central line indicates the median, the box bounds show the interquartile range (25th–75th percentile), and the whiskers extend to the minimum and maximum values within 1.5 times the interquartile range. Individual points outside this range are plotted as outliers.

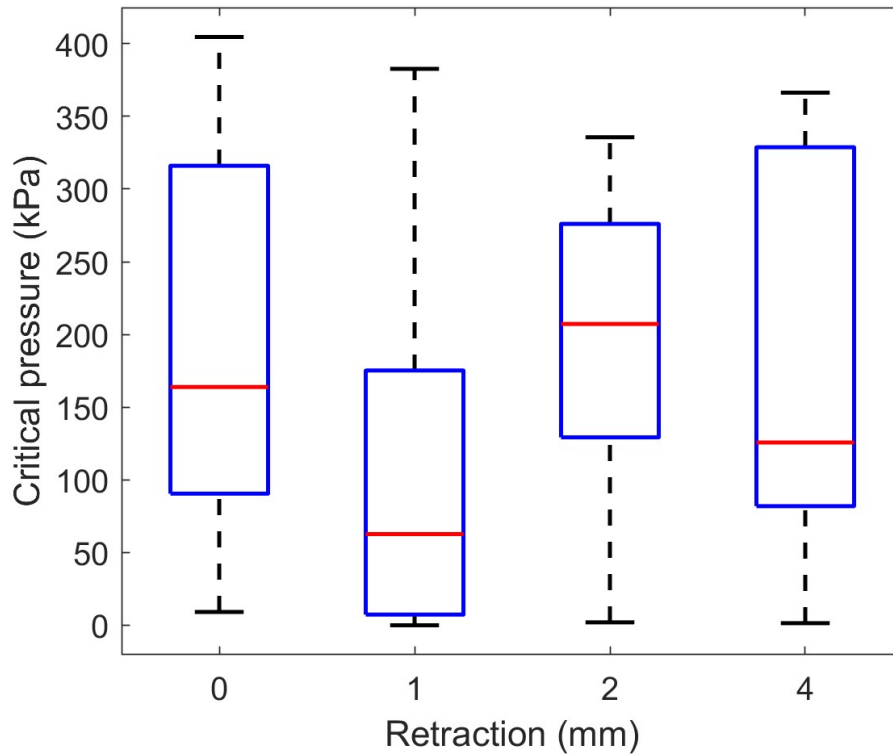


Figure S4: Fluid injection critical pressure variations in gelatin as a function of retraction depth. Box plots represent the distribution of critical pressure values across all valid tests at each retraction level. For each box, the central line indicates the median, the box bounds show the interquartile range (25th–75th percentile), and the whiskers extend to the minimum and maximum values within 1.5 times the interquartile range. Points outside this range are plotted individually as outliers.