

DEVELOPING A METHOD OF SLOWING TISSUE DEGRADATION THROUGH TEMPERATURE, SODIUM BICARBONATE AND ANTIBIOTICS FOR TRAUMATIC BRAIN INJURY TESTING

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INTRODUCTION

- Traumatic brain injuries (TBI) are a common result from vehicle crashes, accounting for 33% of all injury related deaths.^{1,2}
- Brain material properties alter as post mortem time progresses.^{3,4} In order to study TBI, the most *in vivo* like condition of the post mortem brain must be used to get the most meaningful test results.
- Increase of H⁺ ions and bacteria breakdown post mortem brain tissue. Previous studies have sought to slow down this degradation process in organs and skin tissue by using custom antibiotic solutions and temperature control^{3,4}.
- Sodium bicarbonate has been used clinically to minimize the increase in H⁺ ions, but has not been used previously for post mortem testing.
- This study sought to determine a method to delay brain tissue degradation in post mortem brains by using antibiotics³, and sodium bicarbonate solutions.

MATERIALS & METHODS



Figure 1: Cutting Specimen with Die

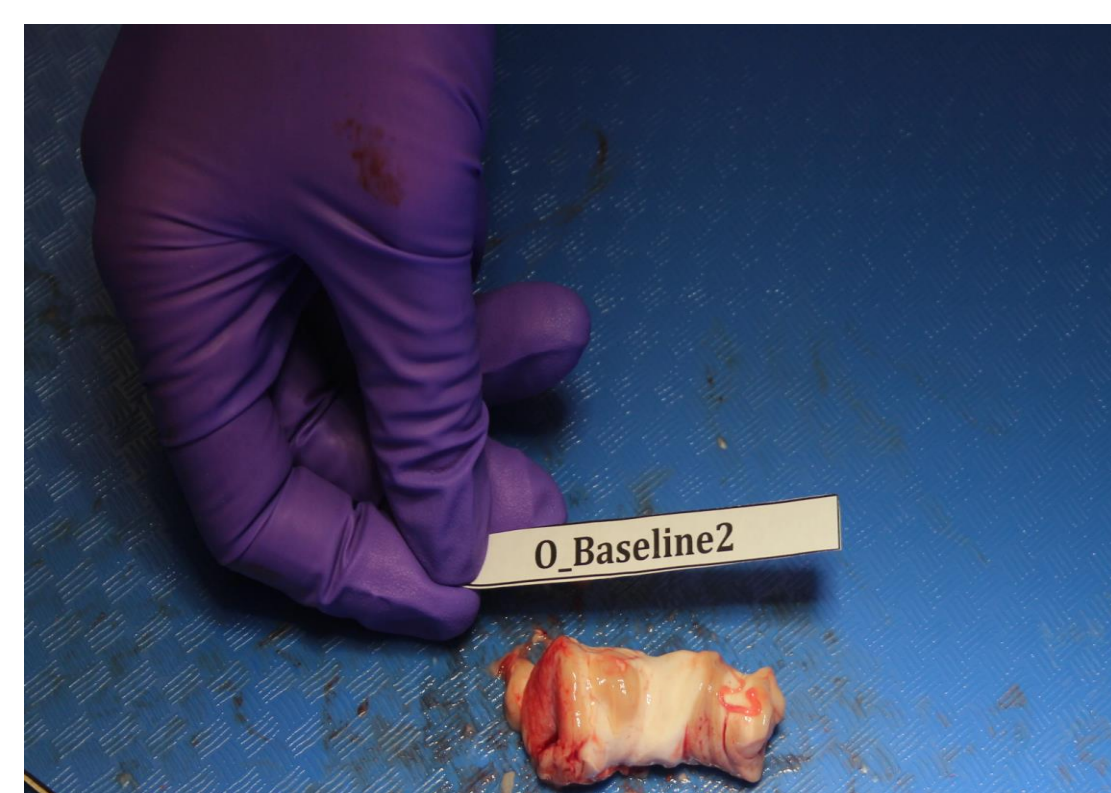


Figure 2: Specimen Out of Brain

- A Post Mortem Human Subject (PMHS) was used in this study. The PMHS died of pneumonia, was 67 years of age, and was acquired 32 hours post mortem.
- The whole brain was removed from the cranial cavity with no dura or brainstem attached.
- Specimens were cut from the Frontal, Parietal, and Occipital lobes using a 5/8" cylindrical cutting die (Figure 1)
- Each specimen was trimmed to 25 mm (Figure 2) and then placed in one of four artificial cerebrospinal fluid solutions (aCSF) (Figure 3).
- Baseline specimens were tested immediately after harvest.
- Solution specimens were refrigerated for 24 hours at 9 degrees Celsius in their respective solutions before testing.
- Compression tests were performed on cylindrical brain specimens to investigate the effect that sodium bicarbonate, antibiotics, and post mortem time has on brain tissue stiffness.
- A 20 gram weight was dropped on each specimen in the testing apparatus (Figure 4 and Figure 5).

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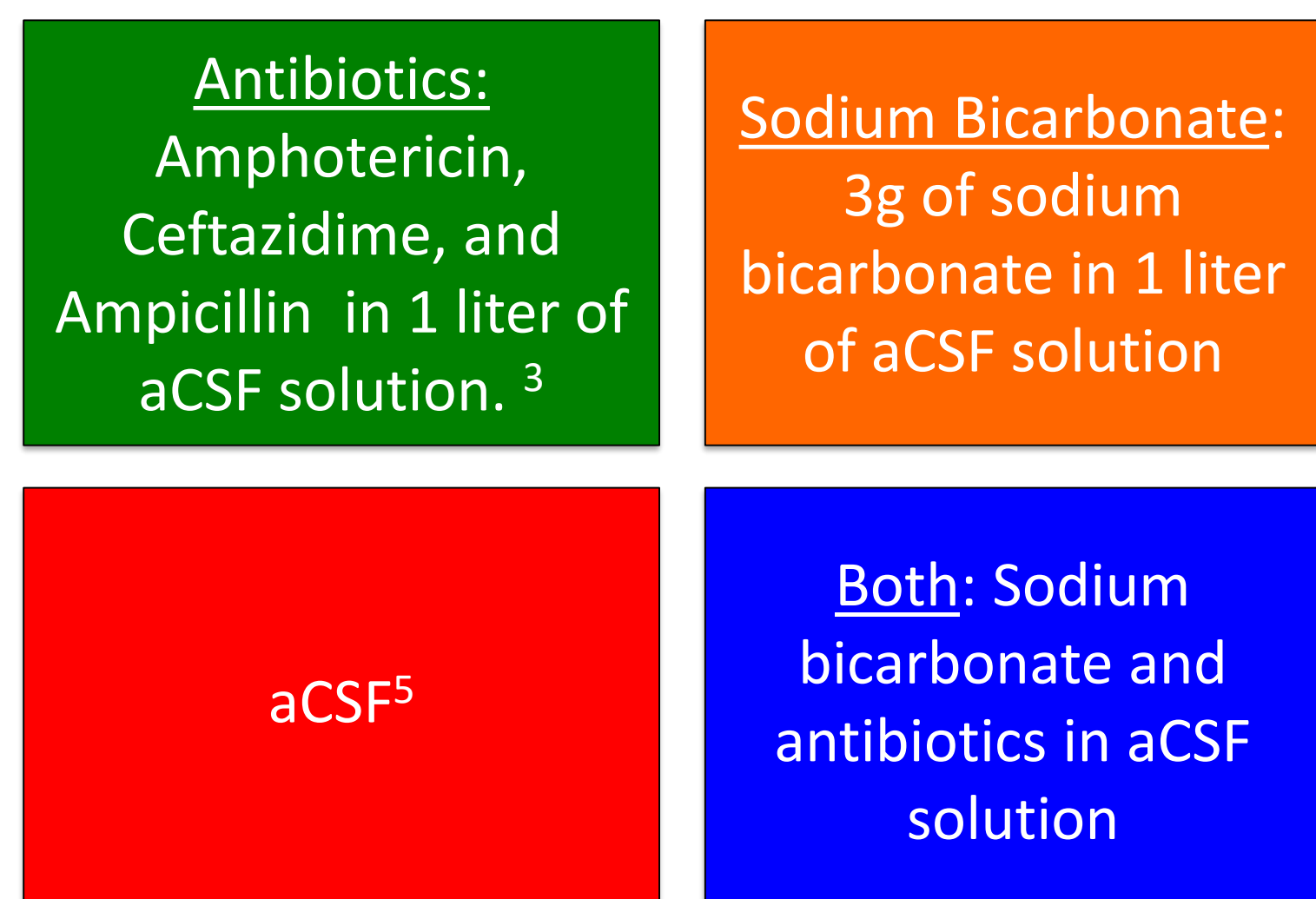


Figure 3: 4 Solutions Used to Soak Specimens

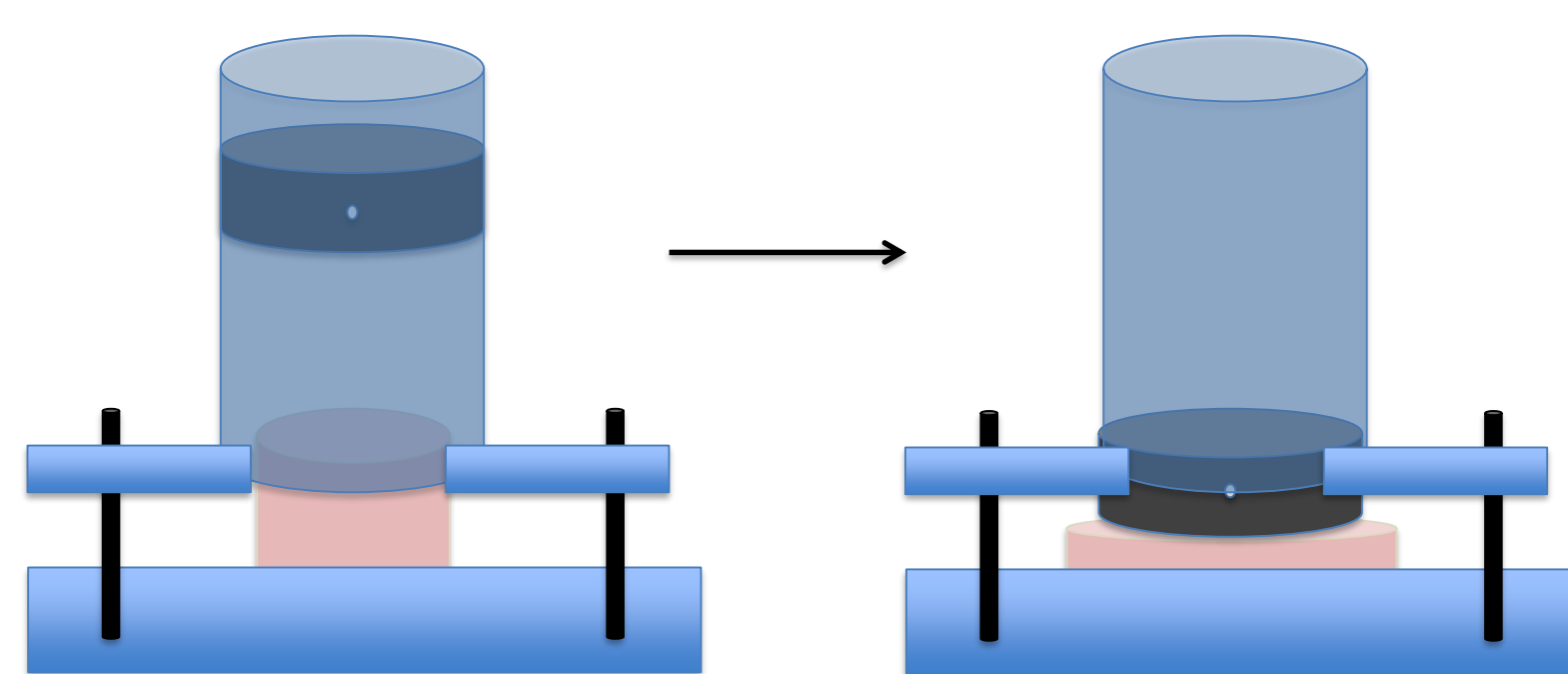


Figure 4: Before and After Weight is Dropped on Specimen

- A high speed camera [AMETEK MiroM320S, Simi Valley, California], 50lb load cell [Transducer Techniques, Temecula, CA] connected to SLICEPRO [DTS, Seal Beach, California] were used to collect force and video capture for each test.
- Stiffness values for each specimen were calculated using the force data from the load cell and the marked weight displacement data from TEMA [Image Systems, Linköping, Sweden].



Figure 5: Compression Test Apparatus

RESULTS & DISCUSSION

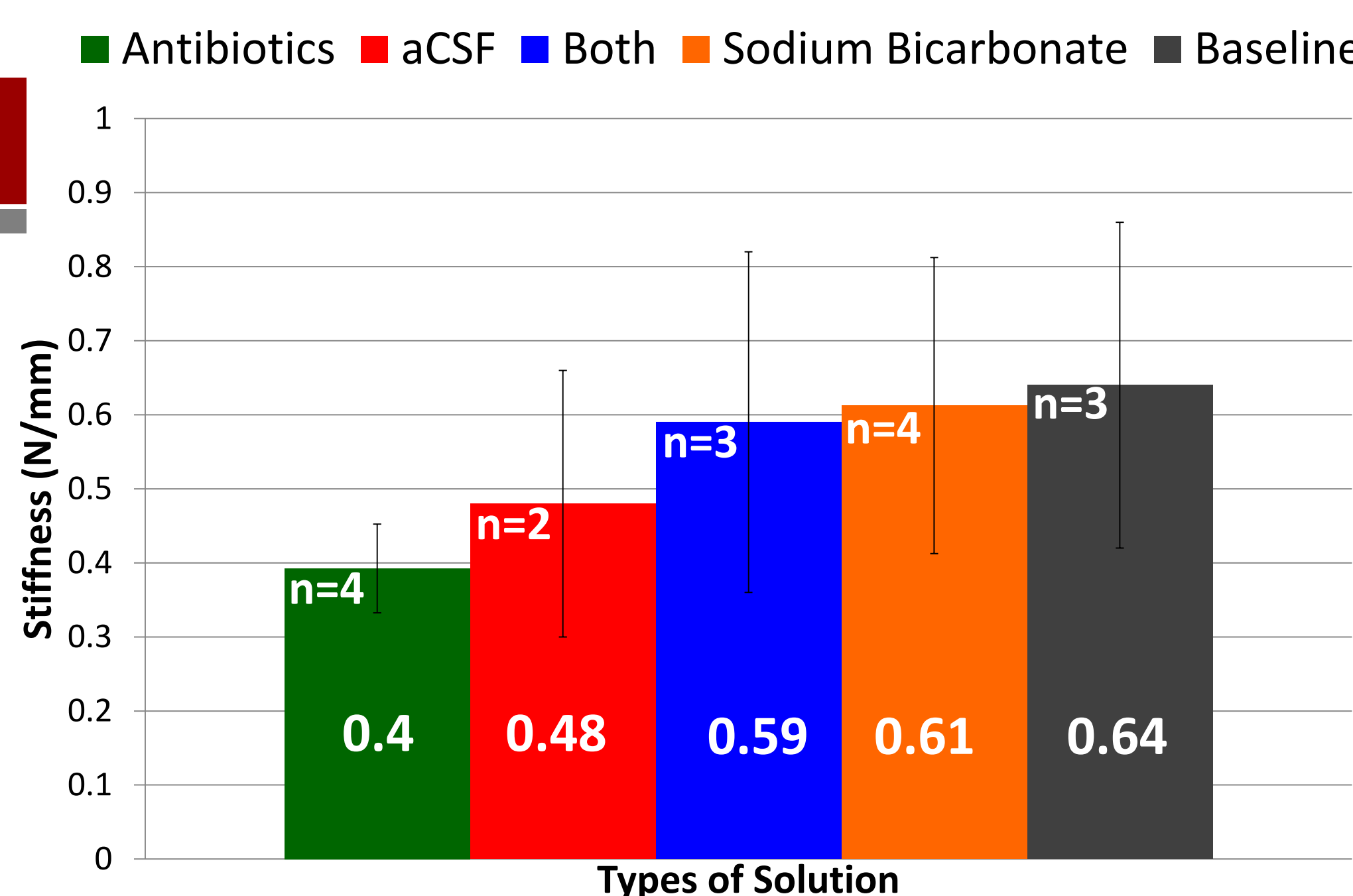
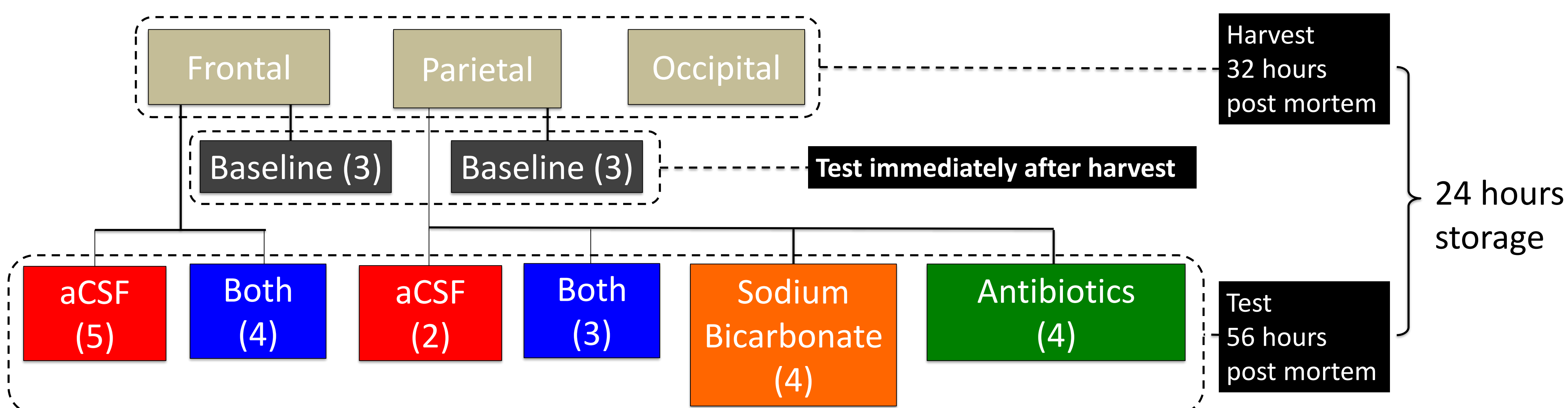


Figure 6: Parietal Stiffness (SD) vs. Types of Solution

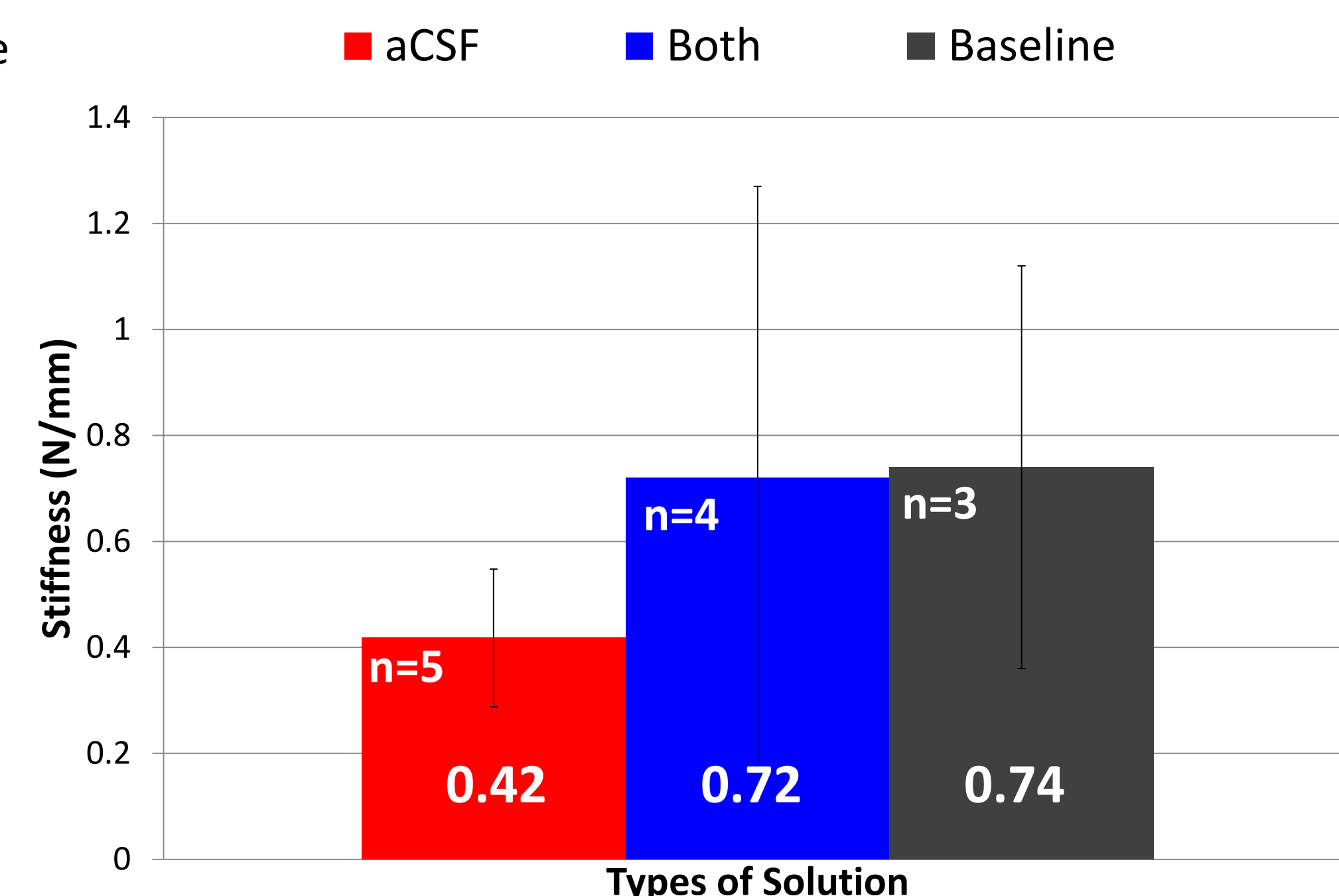


Figure 7: Frontal Stiffness (SD) vs. Types of Solution

- For the parietal lobe, the stiffness values of specimen soaked in sodium bicarbonate or both antibiotics and sodium bicarbonate were closest to the baseline specimen tested immediately after harvest.
- For the frontal lobe, the stiffness values of specimens soaked in both antibiotics and sodium bicarbonate were closest to the baseline specimen tested immediately after harvest.
- Figure 8 shows that little degradation was visible after 24 hours of storage (56 hours post mortem) but the specimens soaked in both antibiotics and sodium bicarbonate solutions showed substantially less degradation than the other specimens after an additional 24 hours (80 hours post mortem).

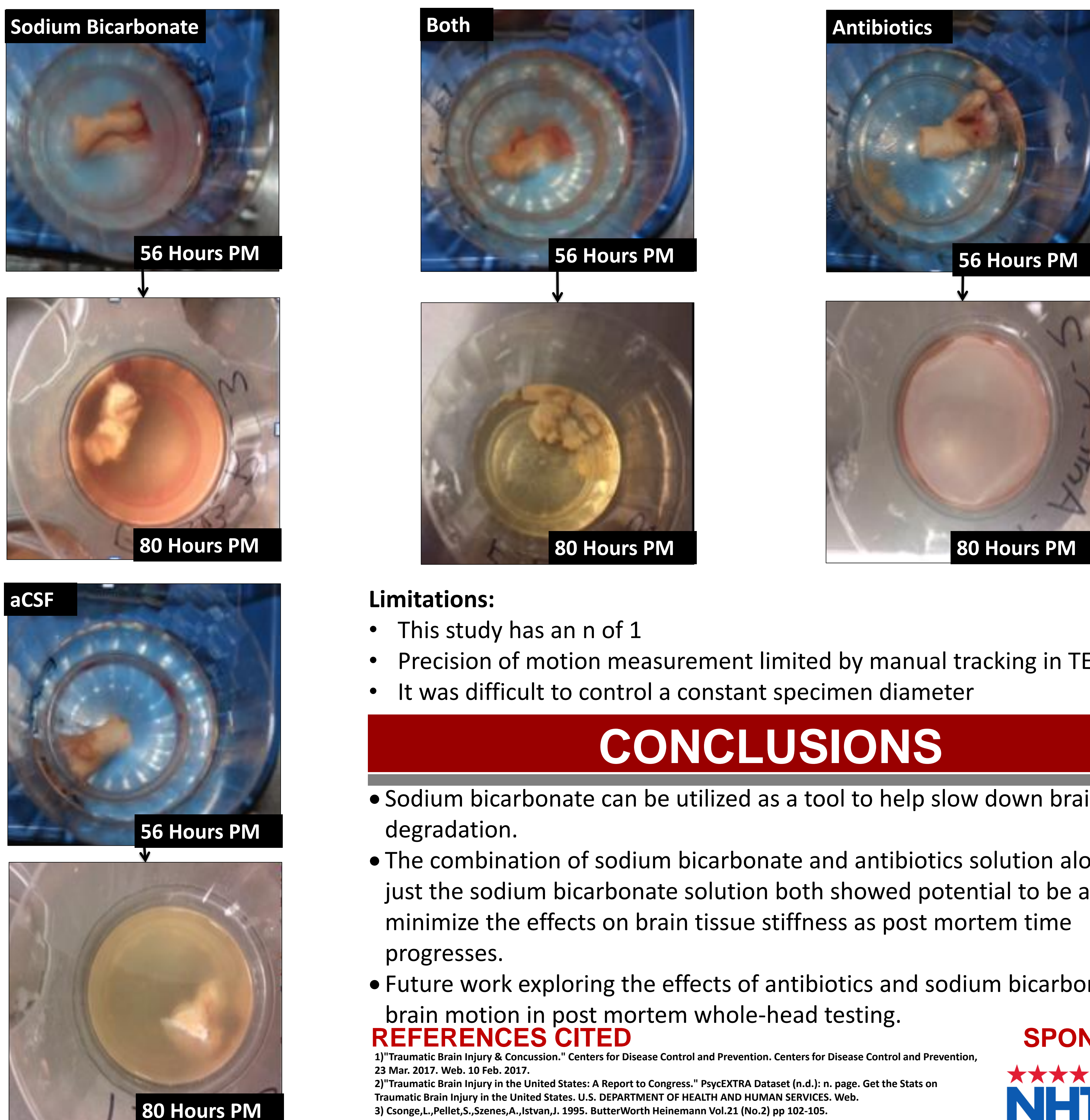


Figure 8: Photographs After 24 and 48 Hours of Storage for Each Solution.

Limitations:

- This study has an n of 1
- Precision of motion measurement limited by manual tracking in TEMA
- It was difficult to control a constant specimen diameter

CONCLUSIONS

- Sodium bicarbonate can be utilized as a tool to help slow down brain tissue degradation.
- The combination of sodium bicarbonate and antibiotics solution along with just the sodium bicarbonate solution both showed potential to be able to minimize the effects on brain tissue stiffness as post mortem time progresses.
- Future work exploring the effects of antibiotics and sodium bicarbonate on brain motion in post mortem whole-head testing.

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