Preliminary MyoGel Analysis

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## Introduction

The MyoGel ultrasound transmission characteristics were evaluated in comparison with distilled water (WATER) and standard ultrasound coupling gel (PhysioMed) (GEL) using an established procedure previously reported in the literature (Poltawski and Watson 2007 a,b)

All experimentation was conducted in a single day. Room temperature and test water temperature were monitored throughout. The test machine was calibrated prior to test commencement and the balance was zeroed between all tests.

Full details of the test procedure, equipment and standardisation procedures can be provided if needed in a more complete documentation.

## Tests

For each of WATER, GEL and MYOGEL, the transmission characteristics (and thus, attenuation) were measured at both 1 and 3MHz at a range of intensities from 0.1 through to 1.0 W $cm^{-2}$ in 0.1 W $cm^{-2}$ steps. The intensities were delivered in a randomised sequence for all tests.

WATER was used as the 'reference' attenuation against which the GEL and the MYOGEL were compared.

5 repetitions were made for each medium (3) at each frequency (2) and at each power density (10) giving 300 measurements (100 of which therefore relate to MYOGEL).

## Data Analysis

The preliminary data analysis consists a series of descriptive statistics for each MEDIUM, graphical representation of the data at each of the two frequencies (as it has been previously established that transmission and attenuation characteristics vary between the 1 and the 3MHZ energies).

A repeated measures ANOVA with Bonferroni post hoc tests were conducted as the most straightforward way to identify whether there were any significant differences in transmission/attenuation between the three media, taking all data points on all repetitions at all intensities. This could be broken down into various sub sets, but even with 300 data points, there is probably insufficient data for a robust sub group analysis. The significance level has been taken at 0.05 throughout as is standard practice. All statistical analysis was conducted using SPSS v 19.0.

## Results

Table 1 provides the summary results for the three media (50 data points for each) across the two delivery frequencies (1 and 3 MHz) at all power levels. The min, max and mean therefore represent a 'meaningless' number which is, in effect, the total power (Watts) delivered across the 50 tests. [so

for the 1MHz in WATER, the 2.278 represents the mean of the 5 data points at 0.1, 5 @ 0.2 etc through to 5 at 1.0). It is not a clinically meaningful number, but is an accurate representation of attenuation across a range of tests].

**Descriptive Statistics**

| | N | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|---|
| 1MHz Water | 50 | .40 | 4.10 | 2.2780 | 1.20709 |
| 1MHz Gel | 50 | .40 | 4.20 | 2.3360 | 1.21488 |
| 1MHz MyoGel | 50 | .40 | 3.80 | 2.1050 | 1.09013 |
| 3MHz Water | 50 | .40 | 4.20 | 2.3080 | 1.23170 |
| 3MHz Gel | 50 | .40 | 4.25 | 2.3180 | 1.23519 |
| 3MHz MyoGel | 50 | .35 | 3.70 | 2.0030 | 1.05494 |
| Valid N (listwise) | 50 | | | | |

Table 1 : summary descriptive statistics for the 300 tests conducted.

The two plots (Figures 1 and 2) represent the overall profile for each MEDIUM at either 1 or 3 MHz, plotting the responses for WATER, GEL and MYOGEL at each intensity (X axis) against the actual output of the machine (Y axis).

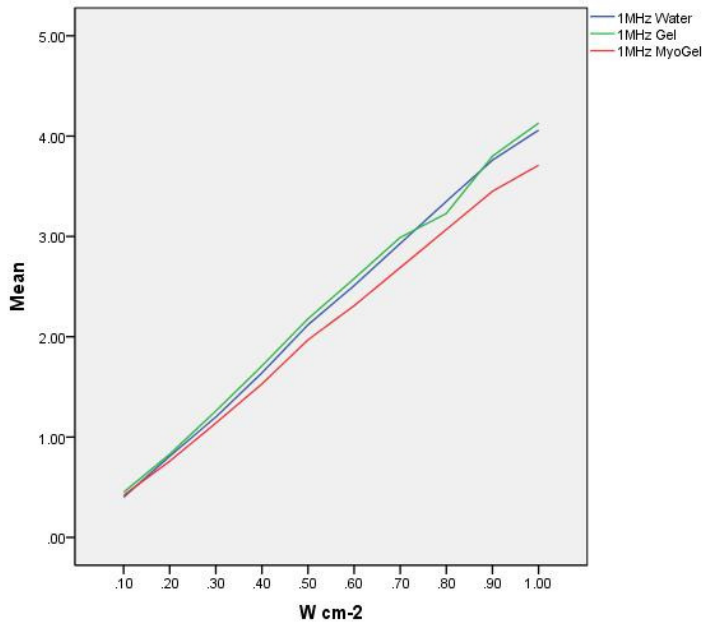


Figure 1 : Transmission of ultrasound at 1MHz across the range 0.1 through to 1.0 W $cm^{-2}$ through the three tested media.

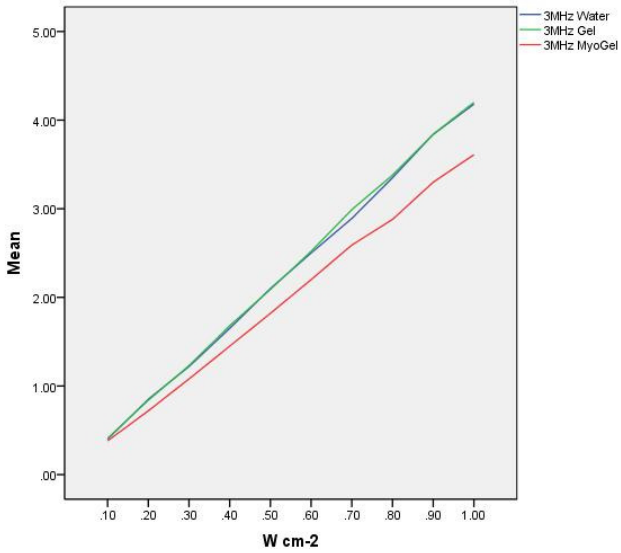


Figure 2 : Transmission of ultrasound at 3MHz across the range 0.1 through to 1.0 W $cm^{-2}$ through the three tested media.

In both cases, it can be seen that the MYOGEL (red line) is less efficient at transmitting the ultrasound energy than either the WATER or the standard GEL. In the case of the 1MHz this averages some 8% reduction compared with water, and at 3MHz, this at approximately 15% reduction. As the delivered power increases, this difference becomes more apparent. Further analysis of this can be conducted as the %variation changes with delivered power, and is not a simple linear relationship.

In terms of the statistical analysis, the repeated measures ANOVA results are reported here in summary only. This test evaluates (a) whether there is a significance difference between the three media and (b) if there is such a significant difference, between which media does the difference exist. As identified previously, significance is taken at the p=0.05 level (i.e. 5% possibility that this result occurred by chance).

## 1MHz ANOVA

The Mulchly test was significant, thus the Greenhouse statistic was employed (less chance of an error)

The MAIN ANOVA statistics : F=116.8, p<0.0001 : thus there IS a significant difference in transmission/attenuation between the three media

The post hoc (Bonferroni) tests identified that :

Water vs GEL : F = 60.2, p<0.0001 : SIGNIFICANT difference

Water vs MYOGEL : F = 95.7, p<0.0001 : SIGNIFICANT difference

GEL vs MYOGEL : F = 142.9, p<0.0001 : SIGNIFICANT difference

## 3MHz ANOVA

The Mulchly test was significant, thus the Greenhouse statistic was employed (less chance of an error)

The MAIN ANOVA statistics : F=139.7, p<0.0001 : thus there IS a significant difference in transmission/attenuation between the three media

The post hoc (Bonferroni) tests identified that :

Water vs GEL : F = 6.1, p<0.017 : SIGNIFICANT difference

Water vs MYOGEL : F = 138.4, p<0.0001 : SIGNIFICANT difference

GEL vs MYOGEL : F = 144.2, p<0.0001 : SIGNIFICANT difference

In addition, I have briefly evaluated the variability of the data and the 95% confidence intervals for the means (not included in this report) and conclude that the data is sound, the results are very closely grouped, and thus the experimental method employed appears robust and reliable.

## Summary

The summary mean data, the plots and the ANOVA tests show that the MYOGEL is LESS EFFICIENT than both WATER and standard GEL in terms of ultrasound transmission. Using the MYOGEL results in a significantly greater attenuation of the energy delivered.

Although these results are statistically significant, the mean difference between the MYoGel and Water is approximately 8% at 1MHz and 15% at 3MHz (this is an average, and it varies across the power range). This may not be clinically as significant as the statistical results imply, in that there is an inaccuracy associated with the machine delivery of energy (up to 20%). The results however are not insignificant in that the differences between all of the gels previously tested was in the order of 1-2%, so the MyoGel is significantly (not used in the statistical sense) worse than either standard gel or water.

It would be prudent to re-run this statistical analysis to ensure accuracy. Further detailed analysis is possible, and with more test data (probably 3 x size of data set) a robust sub group analysis would be possible such that we could test for differences at various power levels - it looks like the attenuation is less of a problem at lower power levels - but with the volume of data available, it is not currently possible to test this hypothesis without risk of serious error.

## References

Poltawski, L. and T. Watson (2007). "Relative transmissivity of ultrasound coupling agents commonly used by therapists in the UK." Ultrasound Med Biol **33**(1): 120-8.

Poltawski, L. and T. Watson (2007). "Transmission of therapeutic ultrasound by wound dressings." Wounds **19**(1): 1-12.