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**PRECIS:** We examined whether the TrueField Analyzer(TFA), a FDA cleared, non-contact, objective perimeter, provides responses in MS that are more determined by "secondary" degeneration than by a history of inflammation. The TFA assesses 44 visual field regions of both eyes in 2 min/eye. Total and pattern deviations, response delay, measurement error, and data on afferent and efferent pupil defects, are provided at every field location. Like our earlier mfVEP study<sup>[Ann Neurol 2005; 57:904–13]</sup> TFA seems to capture disease severity well, regardless of the history of ON.

**PURPOSE:** To examine the diagnostic power of the TrueField Analyser (TFA, **Fig. 1**) in multiple sclerosis (MS).

**METHODS:** 35 normal (47.9 ± 16.8 yr, 22 women) and 85 MS subjects (49.8 ± 11.3 yr, 62 women) were enrolled; including 2 primary and 11 secondary progressives (PS), the remainder relapsing remitting (RR). EDSS scores for RR patients were 3.53 ± 1.04 (mean ± SD), and 5.90 ± 1.43 for PS. The TFA stimuli tested 44 regions/eye within the central 60 deg. The sparse stimuli were delivered at a mean rate of 1/s/visual field region and each persisted for 33 ms on each presentation.

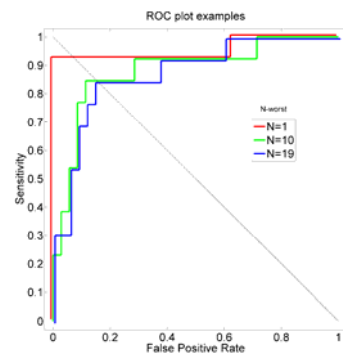
**RESULTS:** %AUC (**Fig. 2**) for the 144 RR eyes was 75.0 ± 3.31 (mean ± SE) and for the 26 PS eyes **94.8 ± 3.55** (mean EDSS **5.90 ± 1.43**). For RR patients that had or had not experienced ON %AUC was 75.7 ± 4.48 and 75.4 ± 3.84 respectively. %AUC for RRMS with EDSS >= 5 (**5.29 ± 0.57**) was **91.4 ± 8.1**.

**CONCLUSIONS:** ON had no significant effect and both RR and PS patients had %AUC consistent with EDSS scores suggesting that the results were more dependent on "secondary" degeneration than inflammation history.



**Figure 1.** TrueField Analyzer (TFA) is an objective perimeter based on multifocal assessment of both eyes at the same time. This provides direct and consensual responses for each of 44 regions of both visual fields, hence 2\*2\*44 = 176 responses in 4 minutes (2 min/eye). The response data includes amplitudes, delays, and SE for all 176 responses.

<http://www.truefield-analyzer.com/>



**Figure 2.** Changes in the area under ROC plots (AUC) as a function of the number of points in the field considered. N indicates a selection of the N-worst deviations from normal performance. The curves are for PS patients using a combination of amplitude and delay data [IOVS 2010; 51: 602-8]. In this case the single worst deviation from normal was the most diagnostic (N=1, red curve).

Response measure	PS	RR	SEs	
Amplitudes	83.1	78.4	5.32	3.61
Times to Peak	90.7	75.5	4.54	3.25
Amp & Delay	<b>94.8</b>	75.0	3.55	3.31

**Table 1.** Comparison of percent area under curve of ROC plots (%AUC) for diagnosis of MS. PS refers to the 26 Primary or Secondary Progressive eyes, RR to the 144 Relapsing Remitting eyes. Mean ± SD EDSS scores were 5.90 ± 1.43 for PS patients, and 3.53 ± 1.04 for all RRMS patients. Three response measures including the response **Amplitudes**, **Times to Peak**, and a combination of the two **Amp & Delay** [IOVS 2010; 51: 602-8]. The %AUC values are the means of results obtained for the worst deviation from normal for a given eye, and the worst 2 deviations for each eye, one or the other always produced the highest %AUC. The SE values at right are similarly the means of the individual SE values for those two cases. All %AUC values are based on asymmetries between the left and right eyes at corresponding visual field locations.

	no ON	ON
EDSS	3.58 ± 0.98	3.48 ± 1.08
%AUC	75.7 ± 4.48	75.4 ± 3.84

**Table 2.** Percent area under ROC plots ± SE for the 144 RRMS eyes analysed separately depending on whether the eye had experienced ON or not (no ON). Mean EDSS scores and %AUC values were similar indicating no effect of ON history. %AUC values were calculated as in Table 1. As in Table 1 the normative data were the median values across each of the 44 stimulus regions, eyes and pupils.

Response measure	EDSS 1 to 3 18 subjects	EDSS 3 to 4 26 subjects	EDSS 4 to 5 21 subjects	EDSS >= 5 7 subjects
Amplitude Asym	71.3 ± 8.0	73.8 ± 6.0	94.3 ± 7.6	91.0 ± 4.9
Time to Peak	72.0 ± 8.5	81.4 ± 7.5	77.3 ± 4.0	<b>91.4 ± 8.1</b>

**Table 3.** Percent area under ROC plots ± SE for the 144 RRMS eyes analysed separately for the response measures: **Times to Peak** and between eye asymmetry in response amplitude (**Amplitude Asym**). Data are presented for four groups of RRMS patients selected by 4 ranges of EDSS scores. Similar %AUC values were obtained for the EDSS > 5 (**5.29 ± 0.57**) group as were obtained for PS subjects who had similarly poor EDSS outcomes (**5.90 ± 1.43**). The number of subjects in each group is indicated below the group labels. Adding the PS subjects made the groups more balanced in numbers but changed the %AUC values very little (not shown). Here the normative data included small but significant effects for Age (-0.14 dB/decade, t=7.5) and Female (add 0.6 dB, t=35.2) although this made little difference (not shown) compared to the median based normative method used in Tables 1 and 2.

**Summary:** The TFA is able to obtain direct and consensual responses for both eyes to 44 stimuli per visual field in 4 minutes (2 min/eye). As in a previous study<sup>[Ann Neurol 2005; 57:904–13]</sup> we were used sparse stimuli and multifocal VEPs the TFA responses depended strongly upon the state of disability and not the history of acute inflammation (ON). TFA may therefore be useful in drug development for MS, or periodic monitoring of patient status in a cost-effective manner.