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Progressione del danno funzionale nel glaucoma: Indici perimetrici, analisi del cluster e correlazione morfologica

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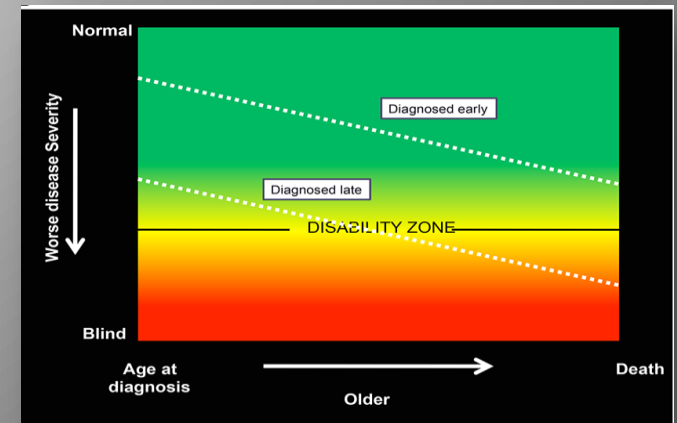
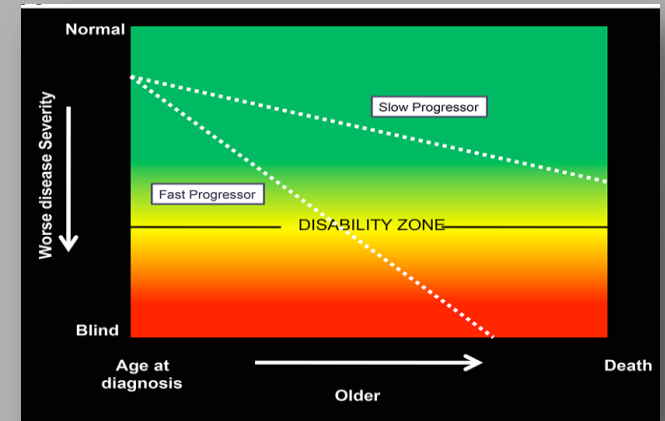
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Progressione del danno funzionale nel glaucoma

- L'esame del campo visivo rappresenta oggi il gold standard per lo studio del glaucoma e per il monitoraggio della progressione della malattia
- La diagnosi precoce e la velocità di progressione della malattia sono fattori importanti per intervenire con trattamenti terapeutici appropriati.



Progressione del danno funzionale nel glaucoma

- Analisi dell'evento (**Event-based Analysis**)
valuta il peggioramento di un difetto perimetrico rispetto al campo visivo basale.
 - GPA (Guided Progression Analysis)
- Analisi della Tendenza (**Trend-based Analysis**)
*studia la velocità di progressione di un danno funzionale (**rate of change**) e ne valuta il rischio associato.*
 - Regressione lineare degli indici globali (MD, VFI, PSD)
 - Regressione lineare punto-punto (PLR)

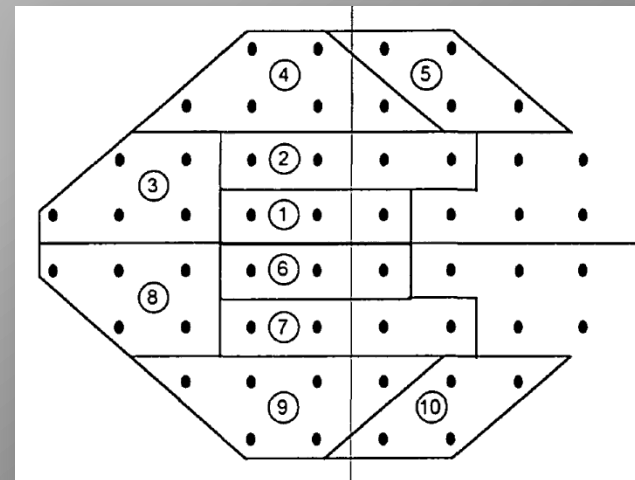
Analisi del Cluster

.... più recentemente...

- L'analisi del Cluster (**Cluster analysis**)

studia il trend di progressione su gruppi di punti contigui (clusters), utilizzando i valori di sensibilità misurati negli stessi punti del campo visivo in esami successivi.

- Fornisce informazioni aggiuntive sulla **distribuzione spaziale** della malattia favorendone la diagnosi precoce.
- Identifica le zone in peggioramento consistenti con l'**anatomia** (più specifico della “punto-a-punto”)



- Cho HK et al. Comparison of the progression rates of the superior, inferior, and both hemifield defects in normal-tension glaucoma patients. Am J Ophthalmol. **2012**; 154(6): 958-968
- Bresson-Dumont H et al. Visual field progression in glaucoma: cluster analysis; J Fr Ophtalmol. **2012**; 35(9):735-41.
- Raza AS1, Zhang X, De Moraes CG, Reisman CA, Liebmann JM, Ritch R, Hood DC, Improving glaucoma detection using spatially correspondent clusters of damage and by combining standard automated perimetry and optical coherence tomography, Invest Ophthalmol Vis Sci. **2014** Jan 29;55(1):612-24.

Comparison of the Progression Rates of the Superior, Inferior, and Both Hemifield Defects in Normal-Tension Glaucoma Patients

HYUN-KYUNG CHO AND CHANGWON KEE

Am J Ophthalmol **2012**;154:958–968.

- Progressione nei 10 GHT clusters
- NTG in fase iniziale: difetti dell'emicampo superiore (cluster 1-6, 3-8) progrediscono più velocemente rispetto all'inferiore → terapia

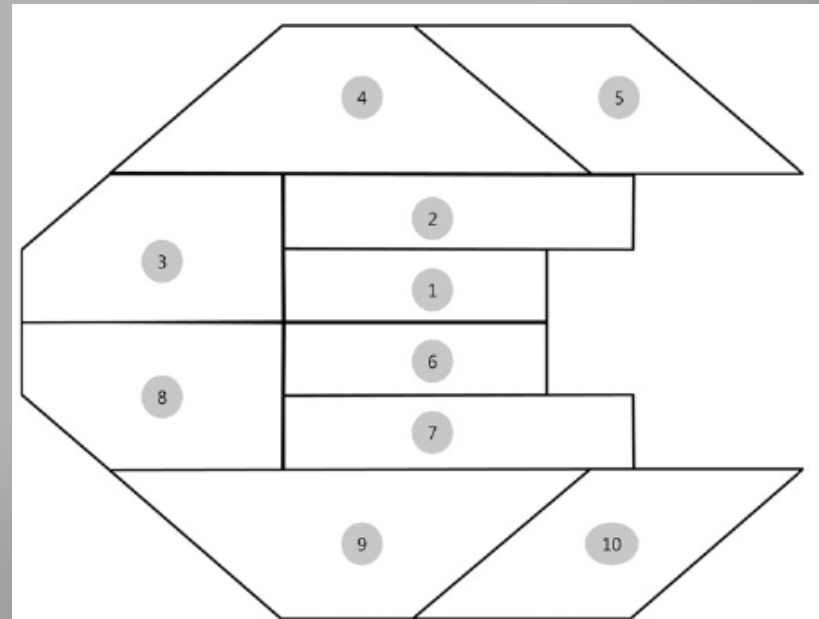


FIGURE 1. Diagram showing the definition of 10 zones of the glaucoma hemifield test.

Progression du champ visuel dans le glaucome : intérêt de l'analyse de l'évolution des clusters[☆]

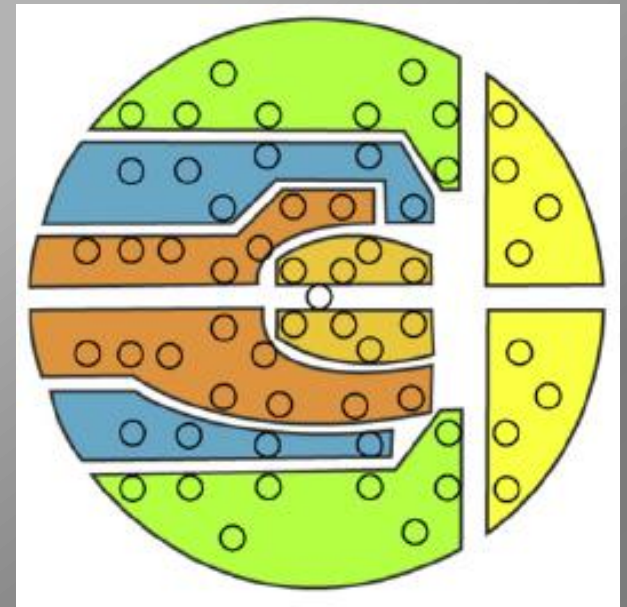
Visual field progression in glaucoma: Cluster analysis

H. Bresson-Dumont*, J. Hatton, J. Foucher,
M. Fonteneau

Journal français d'ophtalmologie (2012) 35, 735-741

Eysuite Octopus Perimetry Clusters

- Progressione in almeno un cluster nei pazienti stabili all'analisi del trend degli indici globali
- Nei pazienti con progressione in almeno un cluster la PLR non evidenzia peggioramenti significativi



Obiettivo

- Capacità dell'analisi del cluster di identificare la velocità di progressione (RoP) di un difetto del campo visivo e confronto con gli indici globali (MD, VFI) e GPA
- Correlazione morfologica con i dati della Rim Area (RA) ottenuta dall'HRT

Comparison of global visual field indices (MD, VFI), GPA II change and cluster analysis of visual field progression in glaucoma

V. Bono^{1,2,3}, B.M. Davis¹, E.M. Normando^{1,2}, L. Crawley², F. Ahmed², S. Cillino³, P. Bloom², M.F. Cordeiro^{1,2}

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INTRODUCTION

Global visual field indices, such as Mean Deviation (MD) and Visual Field Index (VFI) are commonly used to evaluate glaucoma rate of progression (RoP), along with Guided Progression Analysis (GPA). Recently, linear regression analysis of average threshold sensitivity in visual field clusters has been advocated as potentially being valuable in identifying early progression^{1,2,3}. This study aimed to compare all these methods.

METHODS

62 eyes from OHT and glaucoma patients with a minimum of 5 reliable visual field tests (HFA II 24-2) and a follow-up > 4 years were analyzed retrospectively. GPA progression was assessed by the difference in the number of solid triangles between the reliable last and first tests at the same point location (GPA C). MD and VFI rates of progression were used for trend analysis. Linear regression of clusters defined by the Glaucoma Hemifield Test (GHT) was performed based on the mean threshold in each cluster. Global and clustered rates of VF change were flagged as statistically significant progression if the gradients over time were negative with $p < 0.05$.

RESULTS

The median number (\pm SD) of VFs was 8.66 (± 3.34) over a period 9.28 (± 2.93) years. MD, VFI and GPA C classified 20, 24 and 33 eyes as stable, respectively. Mean rates of progression of MD and VFI were -0.46 dB (± 0.34) and -0.91% (± 0.78) per year, respectively ($\rho = -0.77$, $p < 0.0001$) with good agreement ($k = 0.72$). 26 eyes showed progression in both MD and GPA C (Fig. 2) whereas 25 showed progression in both VFI and GPA C (Fig. 3). Agreement between MD and VFI and GPA C (Fig. 3). Agreement between MD and VFI and GPA C was $k = 0.40$ and 0.46 , respectively. GHT cluster analysis was performed on MD and GPA C stable eyes and showed greater progression (clusters ≥ 1) than both GPA C (40% compared to 15%) and MD (67% compared to 48.5%) with poor and moderate agreement ($k = -0.05$ and 0.52 , respectively).

CONCLUSIONS

MD and VFI analyses performed similarly in determining rate of glaucoma progression and with moderate agreement with event-based GPA. GHT cluster trend analyses showed poor agreement with GPA C in MD-defined stable patients.

The cluster analysis appeared to detect more progression than either MD or GPA C and may strongly suggest that it may be a more sensitive method than global indices for the early identification of glaucomatous visual field loss.

REFERENCES

1. Evans-Davies H et al. Visual field progression in glaucoma cluster analysis. J R Soc Med 2002; 95:100-104.
 2. Cho KR, et al. Comparison of the progression rates of the superior, inferior, and both hemifield defects in normal-tension glaucoma patients. Am J Ophthalmol 2002; 134(1): 958-964.
 3. Nassir-Mahdavi K et al. Predictive rates of visual field progression cluster according to nasal versus the four quadrants. Invest Ophthalmol Vis Sci 2002; 43(12):2994-3000.

FIGURE LEGENDS

Fig. 1: Linear regression of global visual field indices (VFI, MD) and event-based GPA.
 Fig. 2: Percentage (%) of subjects with progression in MD and/or GPA C.
 Fig. 3: Percentage (%) of subjects with progression in VFI and/or GPA C.
 Fig. 4: Correlation of RoP of MD and VFI.
 Fig. 5: Clustered RoP based on GHT

Fig. 1

	Stable	Progressive
MD	20 (32%)	42 (68%)
VFI	24 (39%)	38 (61%)
GPA C	33 (53%)	29 (47%)

Fig. 2

	MD	Both	GPA C
Stable	27.4%	41.9%	4.8%

Fig. 3

	VFI	Both	GPA C
Stable	32.2%	40.3%	6.5%

Fig. 4

Spearman $r = 0.77$
 $P < 0.0001$

Fig. 5

	MD stable	GPA C stable
GHT cluster	40% (8)	67% (22)
Progressive	40% (8)	15% (3)
Stable	60% (12)	85% (17)

UCL

Comparison of visual field progression criteria in glaucoma: cluster analysis and global visual field indices (MD, VFI)

V. Bono^{1,2,3}, B.M. Davis¹, E.M. Normando^{1,2}, L. Crawley², F. Ahmed², S. Cillino³, P. Bloom², M.F. Cordeiro^{1,2}

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³Experimental Biomedicine and Clinical Neuroscience, Ophthalmology Section, University of Palermo, Palermo, Italy

Purpose

Global visual field indices, such as Mean Deviation (MD) and Visual Field Index (VFI) are commonly used to evaluate glaucoma progression. Recently, linear regression analysis of average threshold sensitivity in visual field clusters has been advocated for identifying early progression^{1,2,3}. This study aimed to compare these parameters.

Results

The median number (ASD) of VFs was 8.66 (± 3.34) over a period 9.28 (± 2.93) years. MD and VFI classified 20 (32%) and 24 (39%) as stable, respectively. Mean rates of progression of MD and VFI were -0.46 dB (± 0.34) and -0.91% (± 0.78) per year, respectively ($\rho = -0.77$; $p < 0.0001$) with good agreement ($k = 0.72$). 26 eyes showed progression in both MD and VFI stable eyes and showed 5% and MD (54.2% compared to 20.8%) with poor agreement ($k = -0.1$ and $k = 0.30$, respectively).

Methods

62 eyes from OHT and glaucoma patients with a minimum of 5 reliable visual field tests (HFA II 24-2) and a follow-up > 4 years were analyzed retrospectively. MD and VFI rates of progression were used for trend analysis. Linear regression of clusters defined by the Glaucoma Hemifield Test (GHT) was performed based on the mean threshold in each cluster. Global and clustered rates of VF change were flagged as statistically significant progression if the gradients over time were negative with $p < 0.05$.

Conclusions

MD and VFI analyses performed similarly in determining rate of glaucoma progression. The cluster analysis appeared to detect more progression than either MD or VFI. This suggests it to be a more sensitive method than global indices for the early identification of glaucomatous visual field loss.

References

1. Evans-Davies H et al. Visual field progression in glaucoma cluster analysis. J R Soc Med 2002; 95:100-104.
 2. Cho KR, et al. Comparison of the progression rates of the superior, inferior, and both hemifield defects in normal-tension glaucoma patients. Am J Ophthalmol 2002; 134(1): 958-964.
 3. Nassir-Mahdavi K et al. Predictive rates of visual field progression cluster according to nasal versus the four quadrants. Invest Ophthalmol Vis Sci 2002; 43(12):2994-3000.

Figure 1: Linear regression of global visual field indices (MD, VFI) and event-based GPA.

Figure 2: Percentage (%) of subjects with progression in MD and/or GPA C.

	Stable	Progressive
MD	20 (32%)	42 (68%)
VFI	24 (39%)	38 (61%)

Figure 3: Percentage (%) of subjects with progression in VFI and/or GPA C.

	MD	Both	GPA C
Stable	27.4%	41.9%	4.8%

Figure 4: Correlation of RoP of MD and VFI.

Spearman $r = 0.77$
 $P < 0.0001$

Figure 5: Clustered RoP based on GHT.

	MD stable	GPA C stable
GHT Cluster	40% (8)	67% (22)
Progressive	40% (8)	15% (3)
Stable	60% (12)	85% (17)

Table 1: Comparison of MD and VFI stable eyes.

	Stable	Progressive
MD	20 (32%)	42 (68%)
VFI	24 (39%)	38 (61%)

Table 2: Comparison of MD and VFI stable eyes.

	MD Stable	VFI	GHT Cluster	MD
Progressive	40% (8)	5% (1)	54.2% (13)	20.8% (5)
Stable	60% (12)	95% (19)	45.8% (11)	79.2% (19)

Pazienti e metodi

Studio retrospettivo

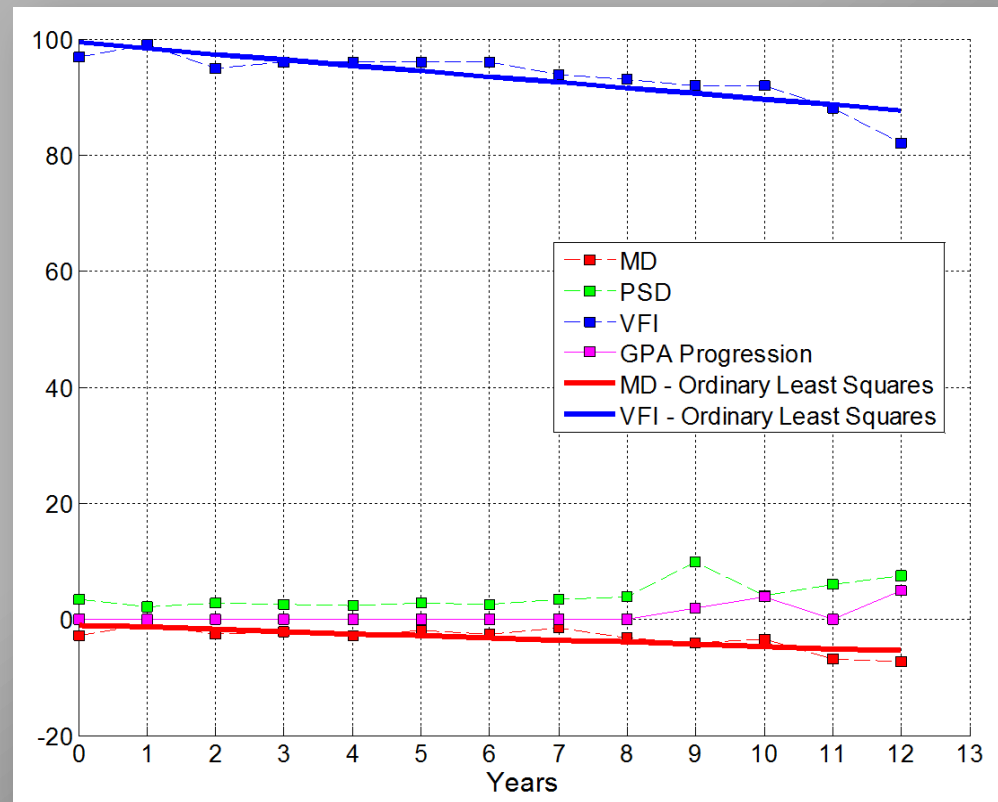
- 62 occhi di 36 pz
- Diagnosi di glaucoma ad angolo aperto
- Follow up > 4 anni
- Presenza di almeno 5 VF e 5 HTR attendibili
- Humphrey Visual Field Analyser , Sita standard 24-2
- Perdite di fissazione <25%, falsi negativi e falsi positivi <15%
- Hrt 3: deviazione standard <40micrometri

Parameter	Mean	SD	Range
Age (years)	69.75	12.41	37 to 91
Follow-up (years)	9.28	2.93	4 to 14
VF number	8.66	3.34	5 to 18
Basal VFI (%)	91.01	11.5	40 to 99.63
Basal MD (dB)	-3.49	3.43	-13.81 to 0.241

Analisi del Trend

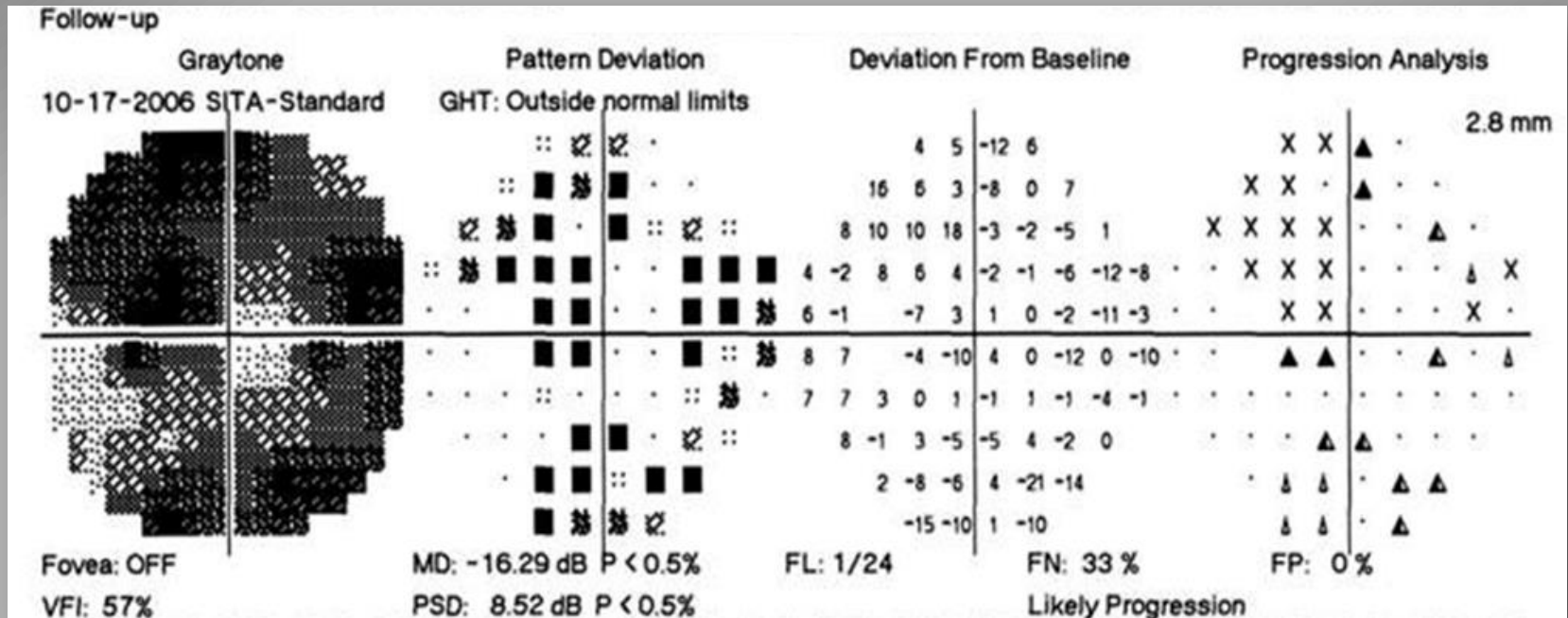
- Regressione lineare degli indici globali nel tempo per calcolare la velocità di progressione del danno funzionale

Progressione significativa:
pendenza della retta di regressione negativa con $p < 0.05$



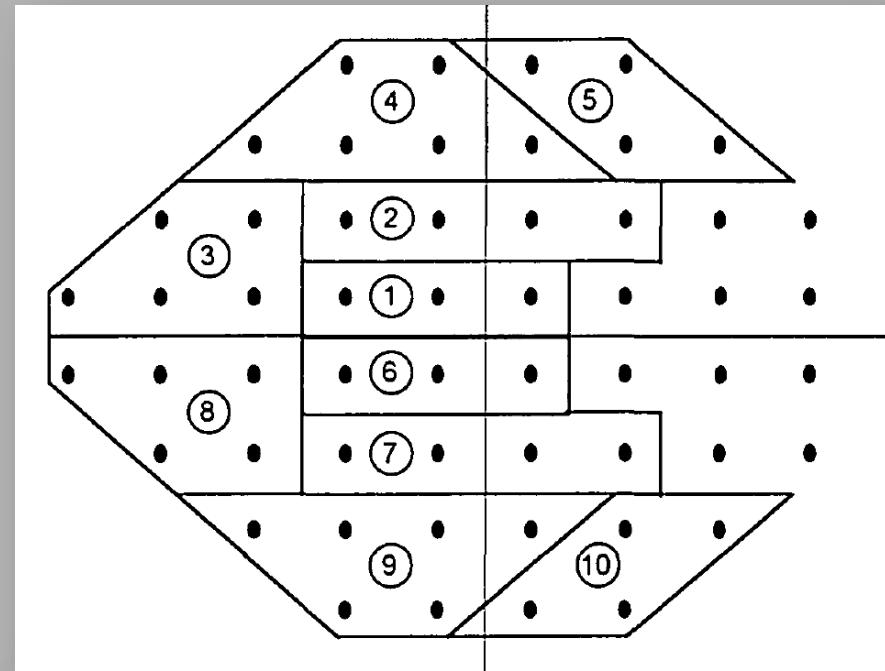
Guided Progression Analysis

- GPA C**: differenza dei triangoli neri tra l'ultimo campo visivo attendibile e il primo in cui è presente un peggioramento statisticamente significativo della sensibilità nello stesso punto test.



Analisi del Cluster

- Clusters definiti dal GHT
- Sensibilità media per cluster
- Regressione lineare di ciascuno dei 10 clusters nel tempo (campi visivi successivi) e calcolo della RoP
- **Progressione al cluster:** se progressione significativa in almeno 1 dei 10 clusters

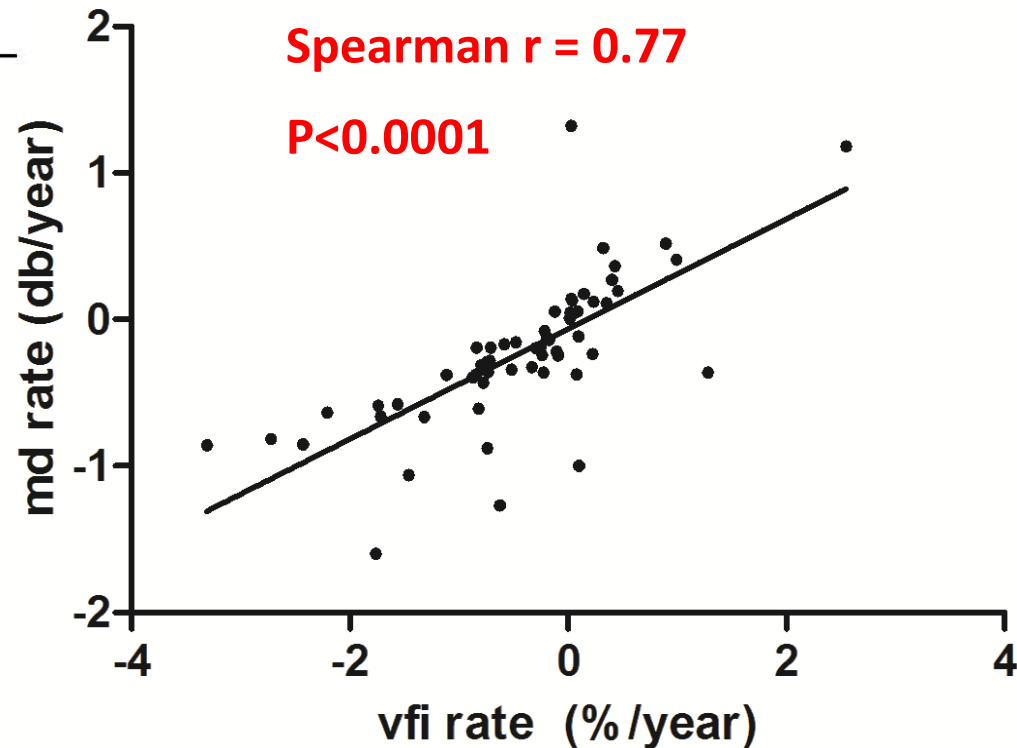


Risultati

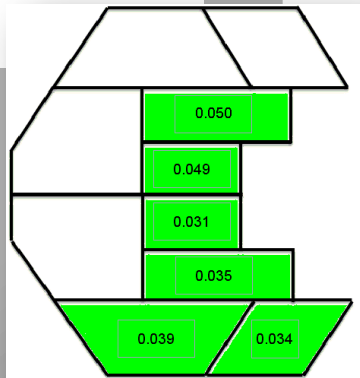
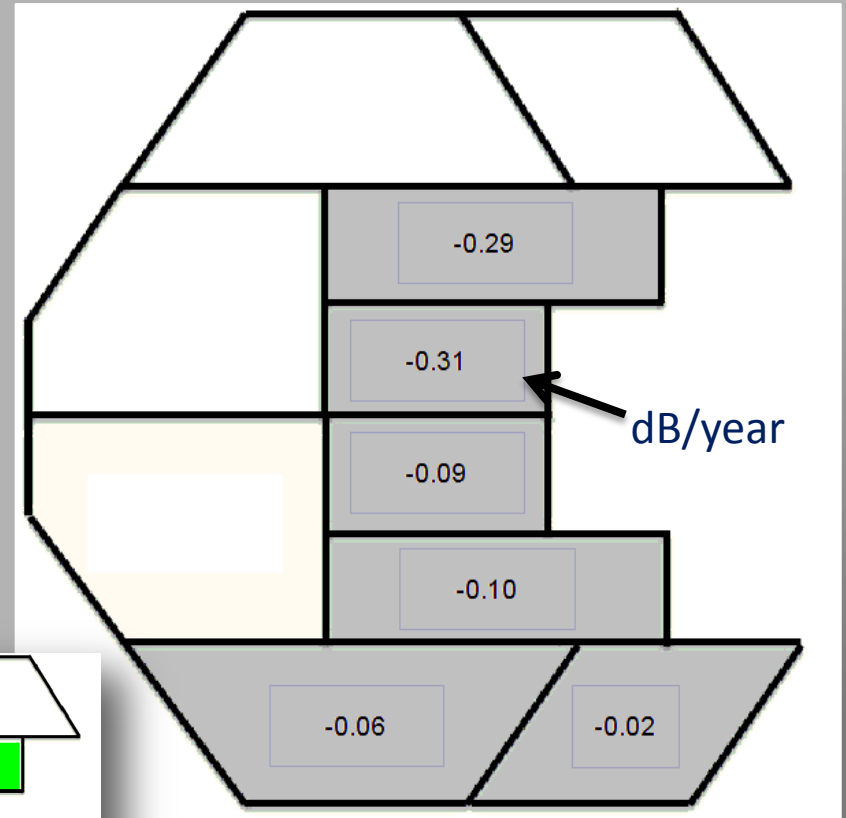
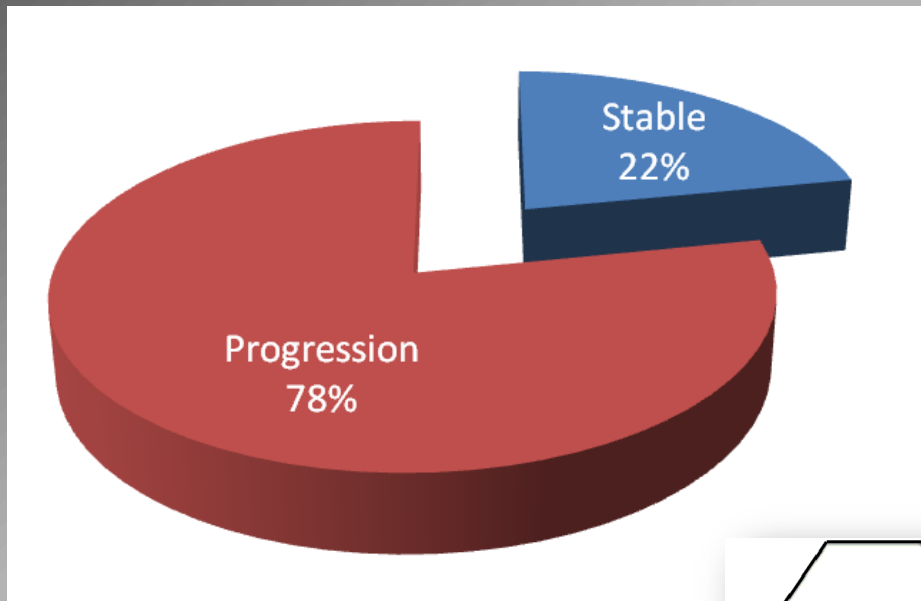
	Stable		Progressive	
	<i>Number</i>	<i>(%)</i>	<i>Number</i>	<i>(%)</i>
MD	20	(32%)	42	(68%)
VFI	24	(39%)	38	(61%)
GPA C	33	(53%)	29	(47%)

Correlazione significativa tra le due slope!

**MD mean rate:
-0.46 dB /anno
VFI mean rate:
-0.91%/anno**

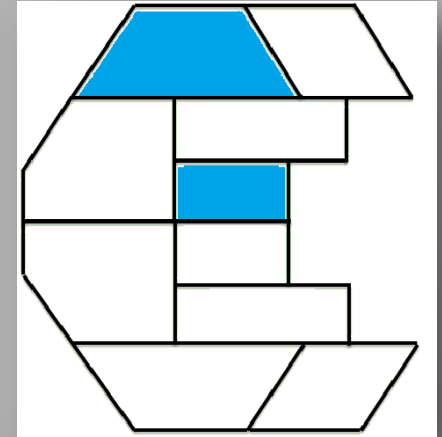
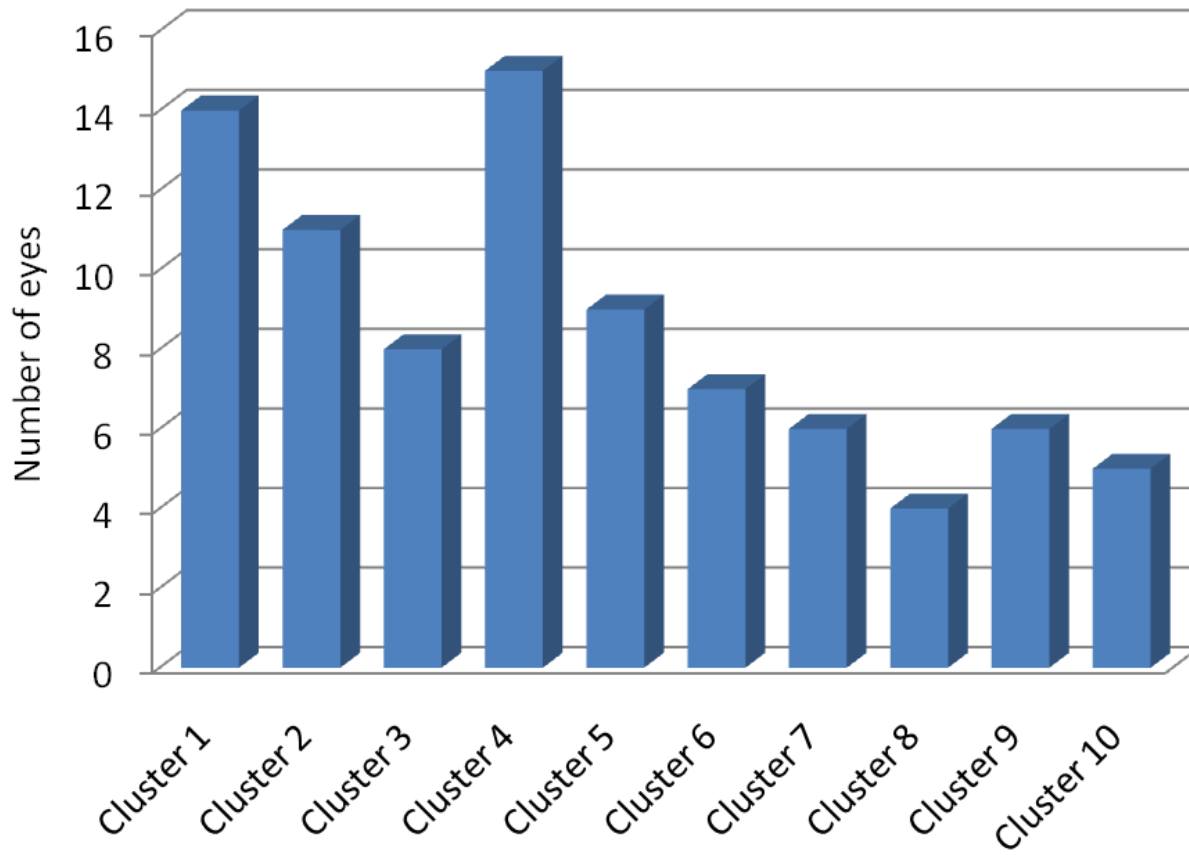


Risultati Cluster

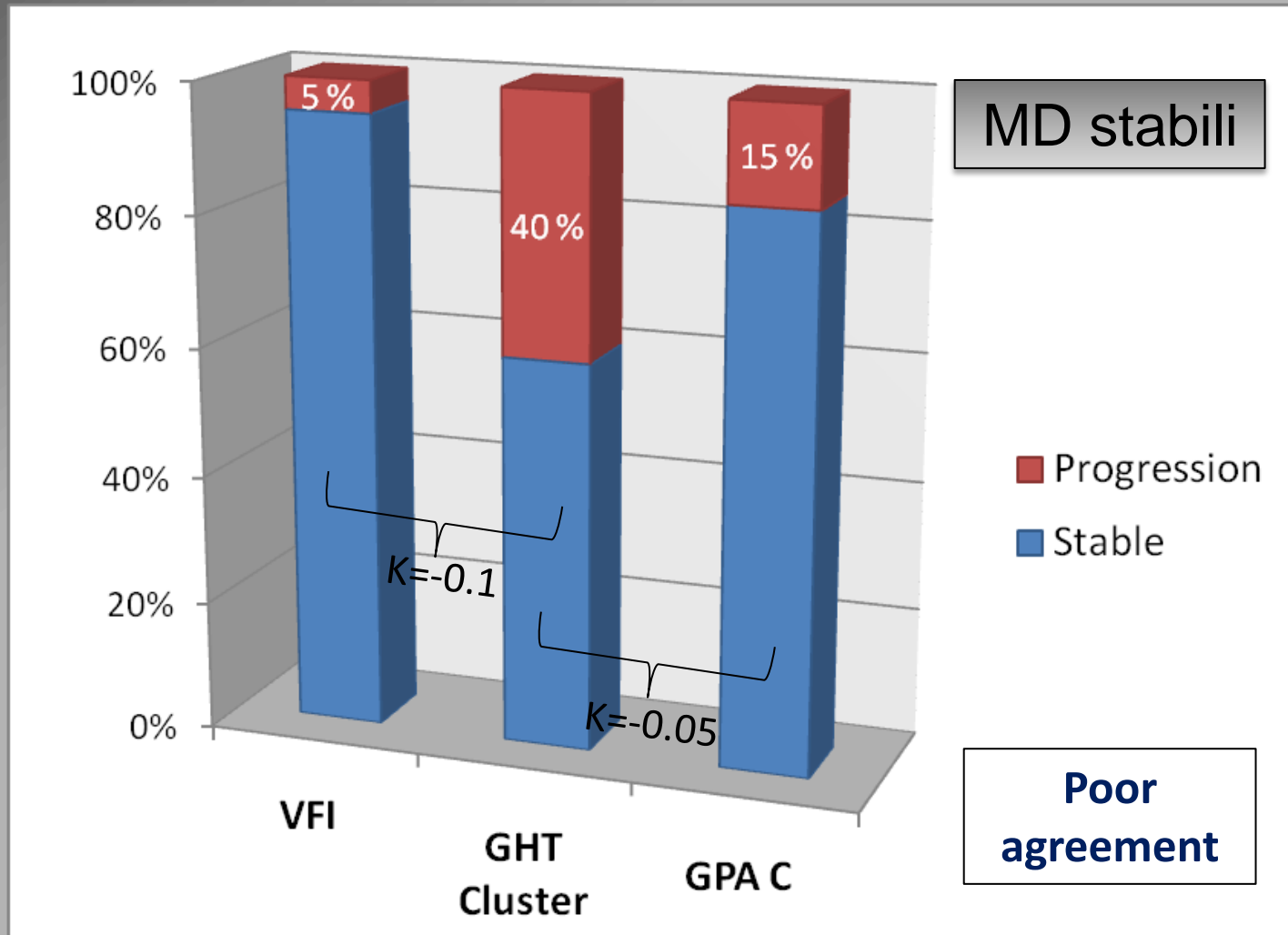


Risultati Cluster

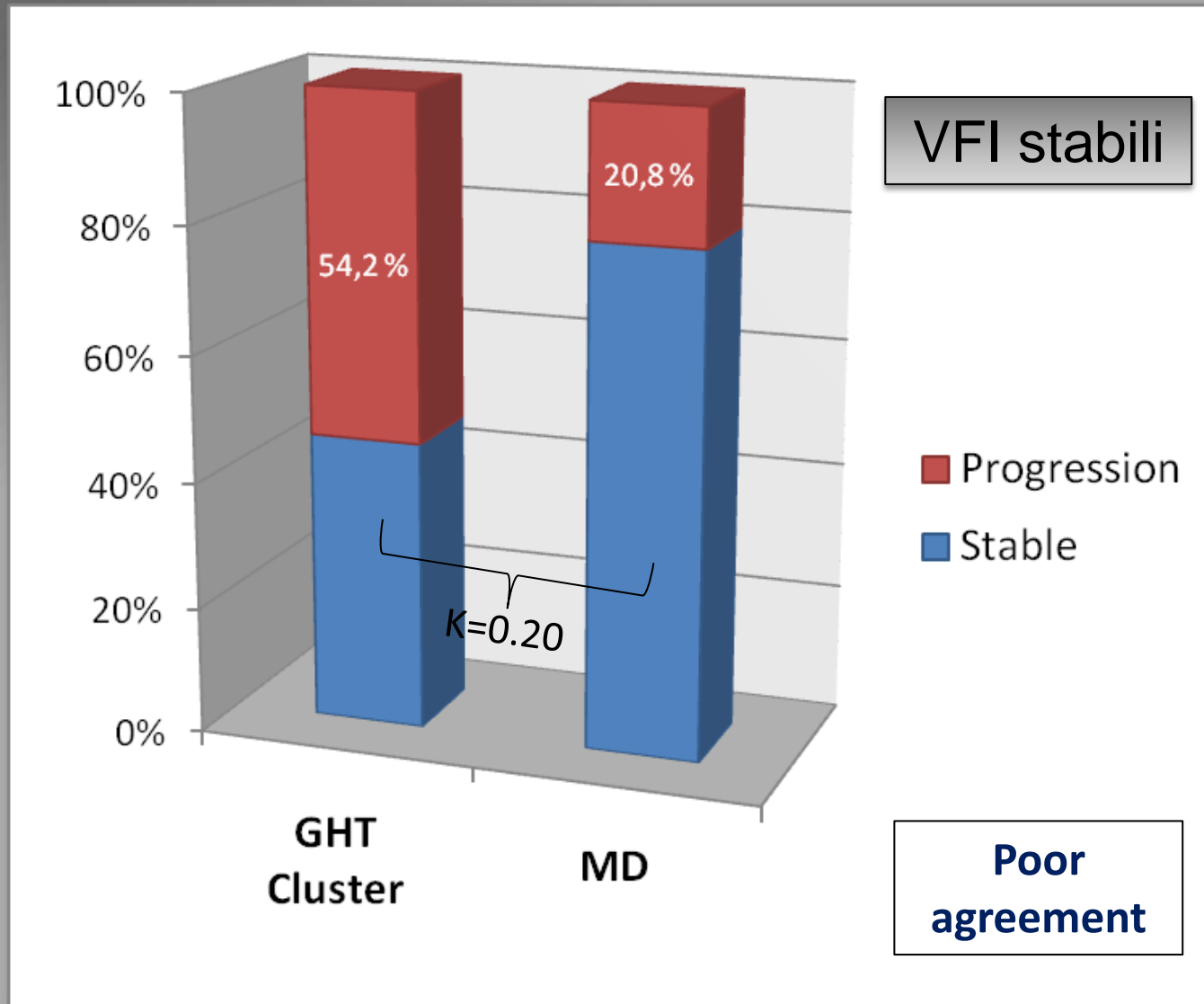
Clustered data progression



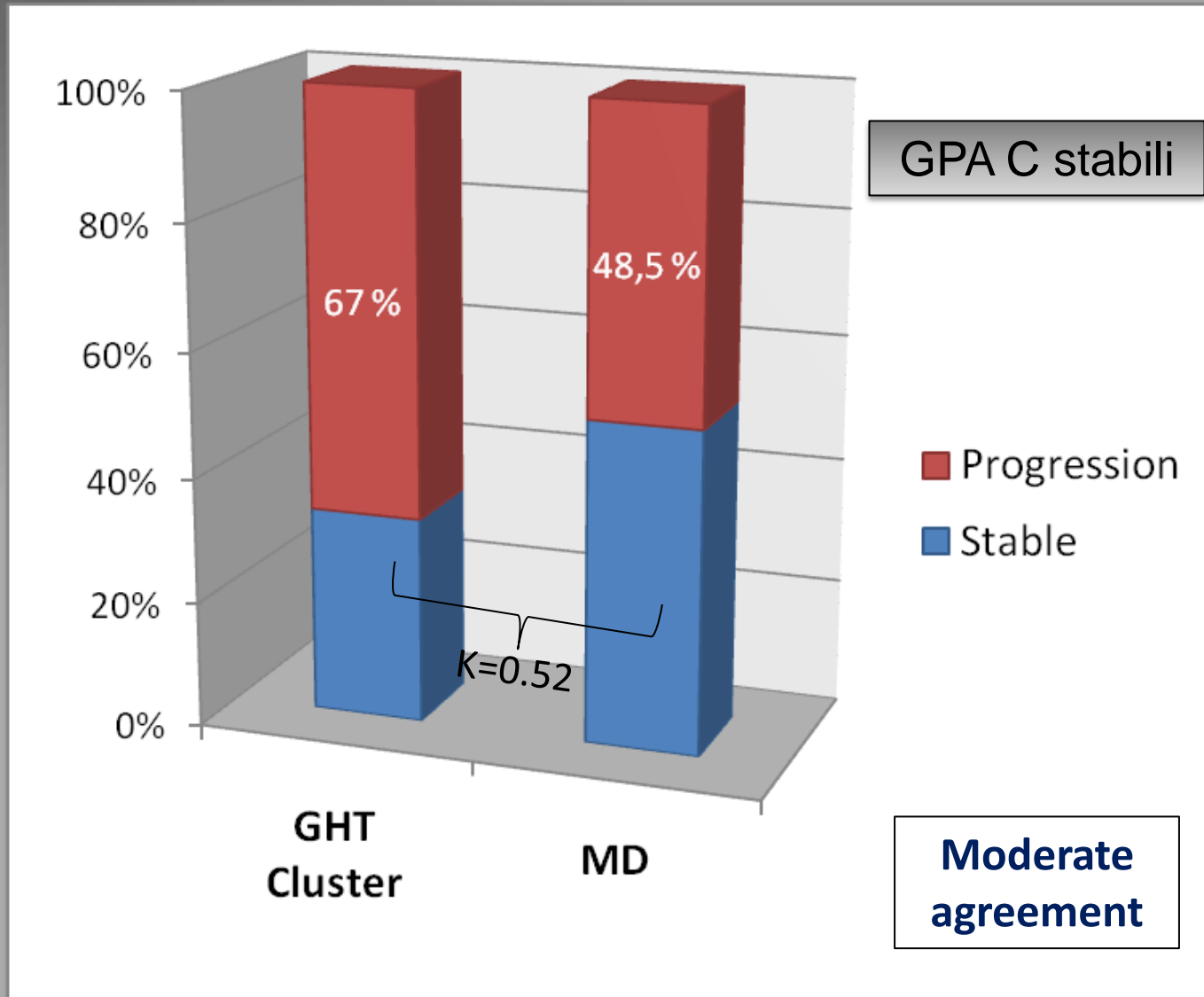
Correlazione tra Cluster e Indici Globali/GPA



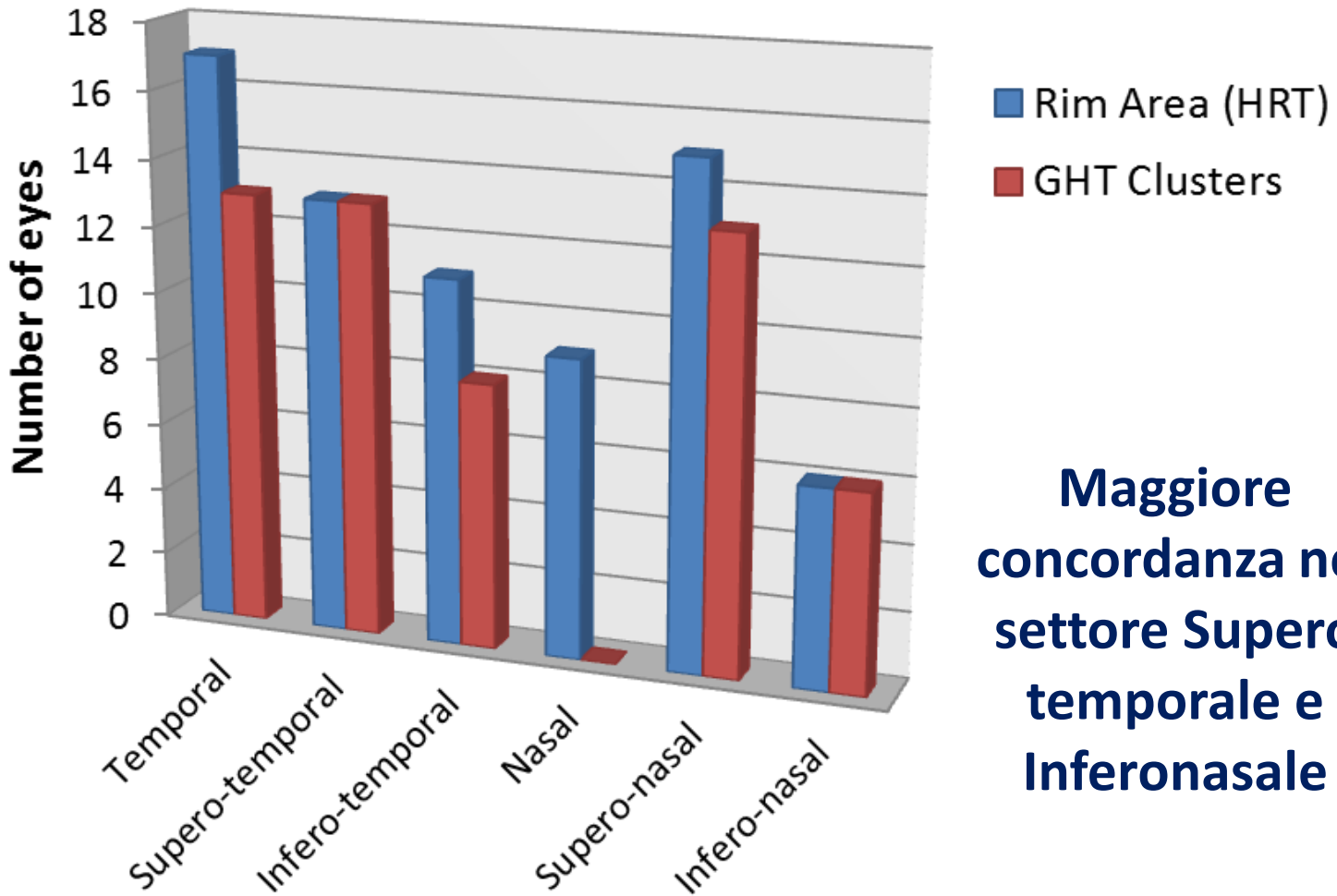
Correlazione tra Cluster e Indici Globali/GPA



Correlazione tra Cluster e Indici Globali/GPA



Correlazione tra Cluster e Rim Area



**Maggiore
concordanza nel
settore Supero
temporale e
Inferonasale**

Conclusioni

- **L'analisi degli indici globali (MD and VFI) ha mostrato risultati simili nell'identificare la velocità di progressione** con una buona correlazione tra i due indici ($K=0.72$). Agreement moderato è stato evidenziato con l'analisi dell'evento GPA.
- **L'analisi del cluster ha individuato un numero di progressioni maggiori rispetto sia alla MD che al VFI.** Basso agreement è stata ottenuto anche con la GPA C nei pz stabili alla MD e al VFI.
- **L'analisi del cluster rappresenta una metodica più sensibile rispetto agli indici globali per la diagnosi precoce dell'alterazione del campo visivo.** I risultati del cluster mostrano anche buona correlazione con l'assottigliamento della Rim Area.

Bibliografia

- V. Bono, B.M. Davis, E.M. Normando, L. Crawley, F. Ahmed, S. Cillino, P. Bloom, M. F. Cordeiro, *Comparison of global visual field indices (MD,VFI), GPA II change and cluster analysis of visual field progression in glaucoma*, Poster presented @ **ARVO 2014, Orlando, Florida, 4-8 Maggio 2014**
- V. Bono, B.M. Davis, E.M. Normando, L. Crawley, F. Ahmed, S. Cillino, P. Bloom, M.F. Cordeiro, *Comparison of visual field progression criteria in glaucoma: cluster analysis and global visual field indices (MD,VFI)*, Poster presented @ **EGS 2014, Nice, Francia, 7-11 Giugno 2014**
- V. Bono, B.M. Davis, E.M. Normando, L. Crawley, F. Ahmed, S. Cillino, P. Bloom, M.F. Cordeiro, *Cluster visual field progression and its relationship with optic disc changes*, Poster abstract submitted to **ARVO 2015, Denver, Colorado, 3-7 Maggio 2015**

Grazie dell'attenzione