Identification of Oral Ulcer Patterns in Behçet's Syndrome through K-Means Cluster Analysis and Correspondence Analysis

Berceste Polat Akmansoy[1], Burcu Aksoy[2], Şükrü Can Akmansoy[3] , Zehra Özge Çandereli[4], Sarah Sacoor[5], Bindi Gokani[5], Azimoon Bibi[5], Adebowale Adesanya[5], Pareen Desai[5], Umit Karaçaylı[6], Fatma Alibaz Öner[7], Nevsun Inanc[7], Tulin Ergun[8], Meral Yay[9], Haner Direskeneli[6], Farida Fortune[5], Gonca Mumcu[10]

1 Department of Oral and Maxillofacial Radiology, Faculty of Dentistry, Marmara University, Istanbul, Turkey; 2 Institute of Postgraduate Education, Istanbul University Cerrahpasa, Istanbul, Turkey; 3 Department of Prosthodontics, Faculty of Dentistry, Marmara University, Istanbul, Turkey; 4 Department of Health Management, Faculty of Economics and Administrative Sciences, Izmir Kâtip Celebi University, Izmir, Turkey; 5 Barts and The London School of Medicine and Dentistry, Queen Mary University of London, UK; 6 Gülhane Faculty of Dentistry, University of Health Sciences, Ankara, Turkey; 7 Department of Internal Medicine, Division of Rheumatology, Faculty of Medicine, Marmara University, Turkey; 8 Department of Dermatology, Faculty of Medicine, Marmara University, Istanbul, Turkey; 9 Department of Statistics, Faculty of Science and Literature, Mimar Sinan Fine Arts University, Istanbul, Turkey; 10 Department of Oral and Maxillofacial Radiology, Faculty of Dentistry, Istanbul Okan University, Istanbul, Turkey

Introduction

- Although oral ulcer is a common clinical manifestation in Behçet's Syndrome (BS), the definition of '*low oral ulcer activity*' is not clear.
- The aim of the study was to define low oral ulcer activity through K-Means Cluster Analysis and to understand the pattern of oral ulcer activity (OUA) using Correspondence Analysis for the disease management with patient empowerment strategies in (BS).

Method

In this cross-sectional study;

- 526 patients with BS were included from two tertiary centers in Turkey and United Kingdom.
- Disease severity scores reflecting organ involvement were calculated. Patients were then grouped according to organ involvement (mucocutaneous and musculoskeletal vs. major organ involvement).
- Patients with active oral ulcers (n=306) were classified into four clusters based on disease severity score and the number of oral ulcers through K-Means Cluster Analysis.
- Correspondence Analyses (CA) were then used to visualize associations described by categorical variables regarding clusters, disease course, medications (non-immunosuppresive (Non-IS) and IS), gender and regular or irregular tooth brushing habits (RTB vs. ITB).

Results

- K-Means Analysis identified four clusters with homogeneous clinical profiles based on the number of oral ulcer and disease severity score in the group (Figure 1-2).
  Number of oral ulcer and disease severity score according to the Clusters
  2.17±1.13 and 4.28±1,27 in the Low OUA clusters,
  2.19±1.37 and 7.98±1.38 in the Low OUA with Major Organ Involvement clusters,
  7.60±1.88 and 4.77±1.47 in the Moderate OUA clusters
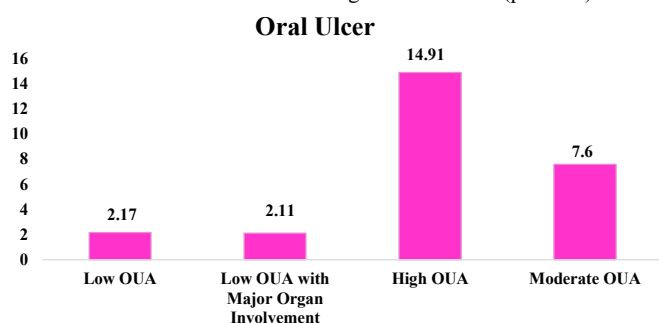 14.91±2.34 and 5.27±1.73 in the High OUA clusters (p<0.001).

Figure 1: The Number of Oral Ulcer According to the Clusters
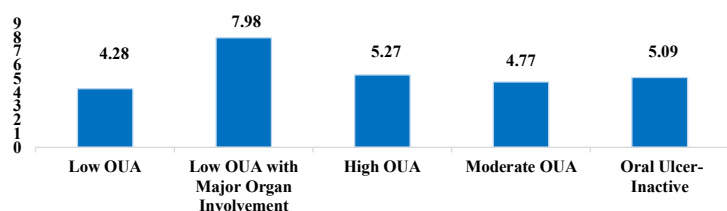

Figure 2: Disease Severity Score according to the Clusters

In Correspondence Analysis,

- "*Low OUA*" cluster was associated with female treated with non-IS medications whereas IS medications were main protocol for both genders in "*Low OUA with Major Organ Involvement*" (Figure 3).
- The ratios of ocular and vascular involvement were :
  19,3 % and 20,8% in Low OUA cluster
  87,5% and 39,7% in the Low OUA with Major Organ Involvement cluster
  43,3% and 10% in the Moderate OUA
  45,5% and 36,4 in High OUA cluster
- *Low OUA with Major Organ Involvement* and *Moderate OUA* cluster represented male patients having ITB habits whereas females were associated with ITB habits in *Low OUA* cluster (Figure 4).
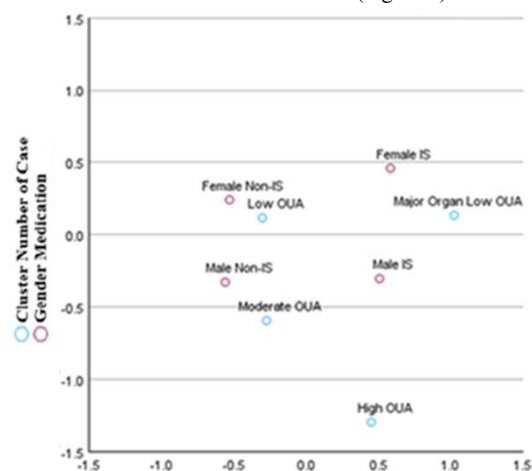

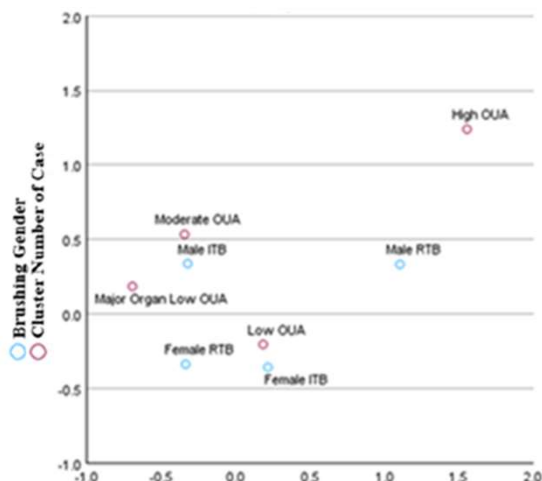**Figure 3:** Relations among the Clusters and Treatment Protocols

Figure 4: Relations among the Clusters, Regular (RTB) and Irregular Tooth Brushing (ITB) habits

Conclusion

- The presence of two oral ulcers could be thought as a cut-off value for low oral ulcer activity although main treatment protocols were different in both low OUA clusters.
- Since RTB decreases the bacterial load in oral environment, ITB could be considered a risk factor for disease management in males, especially treated with ISs. Patient empowerment strategies covering oral hygiene could be helpful for the disease management in BS.