

50. Kadlub N, Chapuis Vandenbogaerde C, Joly A, et al. Speech evaluation after intravelar veloplasty. How to use Borel-Maisonny classification in the international literature? *J Stomatol Oral Maxillofac Surg* 2018;119:107–109
51. Golding-Kushner KJ. Standardization for the Reporting of Nasopharyngoscopy and Multiview Videofluoroscopy: A Report from an International Working Group. *Cleft Palate J* 1990;27:337–348
52. Skolnick ML, McCALL GN, Barnes M. The sphincteric mechanism of velopharyngeal closure. *Cleft Palate J* 1973;10:286–305
53. Coleman SR. Facial recontouring with liposuction. *Clin Plastic Surg* 1997;24:347–367
54. Clavien-Dindo classification. Available at: <https://www.assessurgery.com/clavien-dindo-classification/>
55. Naran S, Ford M, Losee JE. What's New in Cleft Palate and Velopharyngeal Dysfunction Management? *Plast Reconstr Surg* 2017;139:1343e–1355e
56. Ysunza PA, Repetto GM, Pamplona MC, et al. Current Controversies in Diagnosis and Management of Cleft Palate and Velopharyngeal Insufficiency. *BioMed Res Int* 2015;2015:1–11
57. Ysunza A, Chaiyasate K, Micale MA, et al. 22q11.2 deletion detected by endoscopic observation of pharyngeal pulsations in a child with submucous cleft palate and persistent velopharyngeal insufficiency. *Int J Pediatr Otorhinolaryngol* 2014;78:1789–1794
58. Gilleard O, Sommerlad B, Sell D, et al. Nasendoscopy: An Analysis of Measurement Uncertainties. *Cleft Palate Craniofac J* 2013;50:351–357
59. Gart MS, Gosain AK. Surgical management of velopharyngeal insufficiency. *Clin Plast Surg* 2014;41:253–270
60. Perry JL, Kuehn DP, Sutton BP. Morphology of the Levator Veli Palatini Muscle Using Magnetic Resonance Imaging. *Cleft Palate Craniofac J* 2013;50:64–75
61. Perry JL, Sutton BP, Kuehn DP, et al. Using MRI for Assessing Velopharyngeal Structures and Function. *Cleft Palate Craniofac J* 2014;51:476–485
62. Sagar P, Nimkin K. Feasibility study to assess clinical applications of 3-T cine MRI coupled with synchronous audio recording during speech in evaluation of velopharyngeal insufficiency in children. *Pediatr Radiol* 2015;45:217–227
63. Sagar P, Nimkin K. Reply to Dr. Miquel regarding velopharyngeal closure with real-time MRI. *Pediatr Radiol* 2015;45:943–943
64. Kao DS, Soltysik DA, Hyde JS, et al. Magnetic Resonance Imaging as an Aid in the Dynamic Assessment of the Velopharyngeal Mechanism in Children. *Plast Reconstr Surg* 2008;122:572–577
65. Miquel ME, Freitas AC, Wylezinska M. Evaluating velopharyngeal closure with real-time MRI. *Pediatr Radiol* 2015;45:941–942

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The Role of Facial Expression Analysis and Electrodermal Activity as an Objective Evaluation of Persistent Idiopathic Facial Pain

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Abstract: Persistent idiopathic facial pain (PIFP) is an enigmatic condition presenting with variable features. Psychiatric comorbidities are speculated to influence PIFP.

In this study, the authors evaluated patients with PIFP through the hospital anxiety and depression scale, facial expression analysis, and electrodermal activity.

A total of 67 respondents enrolled as the experimental group and 28 participants as the control group. Pain scores were higher in the experimental group (5.24; SD 2.349) $P < 0.001$ depression (5.58 (SD 3.766) versus 3.07 (SD 2.418), $P = 0.002$) and anxiety scores (9.78 (SD 4.923) versus 6.75 (SD 4.097) $P = 0.007$) were higher in the experimental group. The experimental group expressed more negative episodes ($P = 0.024$); Electrodermal Activity data in terms of peaks/min ($P = 0.872$) and average peak amplitude ($P = 0.168$) were not significantly different between the groups.

It may be concluded that pain levels may be influenced by psychiatric comorbidity as PIFP patients showed insignificant physiological response to pain.

Key Words: Anxiety, depression, electrodermal activity, facial expression analysis, persistent idiopathic facial pain

Orofacial pain diagnosis is often complicated, especially when no organic pain or primary orofacial pain disorders are detected through multiple radiological and clinical examinations.¹ In the facial region, that type of pain is related to persistent idiopathic facial pain (PIFP). Diagnosis is also complicated by possible psychiatric comorbidity.^{2,3} In this study, we used self-evaluating questionnaires to assess patients' with PIFP tendency toward affective (mood) disorders and facial expression analysis (FEA) in combination with electrodermal activity (EDA) to objectify the questionnaire data and physiological pain response.

MATERIALS AND METHODS

This was a single-center, cross-sectional, controlled, parallel-group study conducted in the Hospital of LUHS Kaunas Clinics, Department of Oral and Maxillofacial surgery. All respondents signed an informed consent form.

Inclusion/Exclusion Criteria

Adult patients who visited the Hospital of LUHS Kaunas clinics during 2019–2021 were recalled for inclusion in this study. The primary inclusion criteria were that their last known diagnosis in the inner patient register system of the Hospital of LUHS detected as G50.1 (ICD-10) Atypical Facial Pain. After further examination and clarifying whether the condition could be accounted for PIFP (according to ICOP 6.2 PIFP diagnostic criteria), patients were included in the study.¹ We excluded patients with diagnosed

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psychiatric disorders, systemic diseases which may interfere with this study or head and neck oncology, patients with a history of addiction to drugs or alcohol, and pregnant women.

Control group patients were selected with chronic unilateral postfracture mandibular pain, (S02.6 according to ICD-10); 8 weeks after intermaxillary fixation. Exclusion criteria were the same as for the experimental group.

All respondents within this study were asked to discontinue their medication, which may affect pain perception if no negative consequences were expected, 24 hours prior to participation in the study.

Survey Data

Patient pain was assessed using a Visual Analogue Scale (0 = no pain, 10 = unbearable or unimaginable pain).⁴ Patients' tendency toward depression and anxiety was assessed using the Hospital Anxiety and Depression Scale.⁵

Physiological/Biometric data

During the interview, electrodermal activity (EDA) was collected from the left hand with electrodes placed on the palmar side of the medial part of the index and middle finger. The EDA signal was collected using a wireless EDA device (Shimmer3 GSR, Shimmer, Dublin, Ireland) sampling at 128 Hz. Moreover, a video (Mp4 format, 30 fps) of the respondent's face was stored for later postprocessing of facial expressions.

Data Analysis

Electrodermal Activity

The EDA signal from each respondent was analyzed using a peak detection analysis workflow with the purpose of extracting phasic events (peaks). In brief, lowpass Butterworth filters with a cutoff frequency of 5 Hz were applied to remove line noise. A moving average median filter with a window length of 8 seconds was then applied to the filtered signal to extract the phasic component. Lastly, a trough-to-peak analysis was applied to identify phasic events in the signal. A peak was identified as an event lasting for at least 500 ms with an onset threshold of 0.05 μ S and a minimum amplitude of 0.01 μ S. In this paper, the count of peaks/min was used for subsequent data analysis. This value is thought to represent the emotional arousal level of the respondent with a higher peak/min count signifying higher levels of arousal.⁶

Facial Expression Analysis

Analysis of the face recordings was post-processed in the iMotions software using the embedded facial expression analysis module (Affdex 4.0, Affectiva, Boston, MA).⁷ The algorithm outputs likelihood scores for certain facial expressions being present for each video frame. In the present study, valence was used for further analysis. Valence is a probability score that ranges from 100 to -100 where facial expressions of smile and cheek raise increase the likelihood of a positive score, and the facial expression of inner brow raise, brow furrow, nose wrinkle, upper lip raise, lip corner depressor, chin raise, lip press, and lip suck increase the likelihood of negative score.⁸ A valence score above 30% likelihood was considered as positive valence, a score between 30 and -30% likelihood as neutral valence, and a score below -30% likelihood was considered negative valence.

Statistical Analysis

The statistical analysis was performed using IBM SPSS Statistics 20 software with significance level was selected at $P < 0.05$. The interdependence of the qualitative evidence was evaluated by chi-square (χ^2) criteria. We used a nonparametric Mann-Whitney test to evaluate questionnaire, GSR, and facial expression analysis differences between the groups.

RESULTS

Sixty-seven respondents enrolled as the experimental group and 28 enrolled as the control group. There were no differences between the groups in terms of age ($P = 0.644$) and gender ($P = 0.087$). Pain expression was more severe in the experimental group (mean - 5.24; SD 2.349) than in the control group (1.96; SD 2.027), $P < 0.001$. Regarding depression and anxiety scores, the experimental group expressed both higher depression ($P = 0.002$) and anxiety ($P = 0.007$) scores (Supplementary Digital Content, Table 1, <http://links.lww.com/SCS/C841>).

Based on the facial expression analysis, the experimental group patients on average expressed more negative emotions, which include anger, sadness, and fear compared to the control group patients (Supplementary Digital Content, Table 2, <http://links.lww.com/SCS/C841>).

Recordings of EDA revealed that there were no significant differences in EDA peaks/min and average peak amplitude throughout the recording, however, EDA peaks per minute were significantly higher in the experimental group during negative valence (Supplementary Digital Content, Table 3, <http://links.lww.com/SCS/C841>).

DISCUSSION

In this study, we investigated patients suffering from PIFP through self-evaluating questionnaires and recorded their emotional status using FEA and EDA. To our knowledge, this is the first study to evaluate patients with PIFP through subjective self-evaluating questionnaires and an objective emotional arousal evaluation system.

In this study, we found that patients with PIFP may have a tendency toward both depression and anxiety. It is speculated in the literature that the comorbidity between PIFP and affective (mood) disorders exists, although a direct causative relationship has yet to be explained.⁴ As with other chronic pain conditions, it is more likely to be a shared vulnerability to both psychiatric comorbidities and chronic pain conditions.⁴

Considering facial expression analysis, patients with PIFP expressed more negative emotions than control group patients. Although it is difficult to estimate whether facial expression recognition may be a reliant marker for affective (mood) disorders, higher negative emotion outputs may be related to higher experienced pain levels.

It is known that EDA phasic events (peaks) may increase (higher peaks/min) when a patient is experiencing higher levels of pain.⁹ When comparing our EDA data, we have noted that EDA peaks/min did not differ between the groups, nor did their average amplitude of EDA peaks. This evidence is important since the experimental group patients reported higher experienced pain levels compared to the control group, yet their physiological response to that pain was highly homogeneous with the lower-pain control group. It may be concluded that pain levels may be influenced by psychiatric comorbidity as PIFP patients showed insignificant physiological response to pain. A take-away message is that multidisciplinary treatment including psychiatrists may be indicated when considering PIFP diagnosis.

REFERENCES

1. International Classification of Orofacial Pain, 1st edition (ICOP). Cephalalgia. 2020. 40:129–221
2. Benoliel R, Gaul C. Persistent idiopathic facial pain. *Cephalalgia* 2017;37:680–691
3. Taiminen T, Kuusalo L, Lehtinen L, et al. Psychiatric (axis I) and personality (axis II) disorders in patients with burning mouth syndrome or atypical facial pain. *Scand J Pain* 2011;2:155–160
4. Delgado DA, Lambert BS, Boutris N, et al. Validation of Digital Visual Analog Scale Pain Scoring With a Traditional Paper-based Visual Analog Scale in Adults. *J Am Acad Orthop Surg Glob Res Rev* 2018;2:e088

- Zigmond AS, Snaith RP. The hospital anxiety and depression scale. *Acta Psychiatr Scand* 1983;67:361–370
- Braithwaite JJ, Watson DG, Jones R, et al. A guide for analysing electrodermal activity (EDA) & skin conductance responses (SCRs) for psychological experiments. *Psychophysiology* 2013;49:1017–1034
- Kulke L, Feyerabend D, Schacht A. A comparison of the Affectiva iMotions Facial Expression Analysis Software with EMG for identifying facial expressions of emotion. *Front Psychol* 2020;11:329
- Kartali A, Roglić M, Barjaktarović M, et al. Real-time Algorithms for Facial Emotion Recognition: A Comparison of Different Approaches. 2018 14th Symposium on Neural Networks and Applications (NEUREL). 2018:1–4
- Jha RK, Amatya MS, Nepal O, et al. Effect of cold stimulation induced pain on galvanic skin response in medical undergraduates of Kathmandu University School of medical sciences (KUSMS). *Int J Sci Healthcare Res* 2017;2:55–58

Transconjunctival Surgical Access With Modified Aesthetic Lateral Canthotomy

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Abstract: Displaced fractures of the zygomatic bone that require surgical treatment are accessed transcutaneously but these accesses to the skin can cause a hypertrophy scar in patients with this predisposition. This paper indicates a modification in the lateral canthotomy that aim to minimize the hypertrophic scar in the treatment of zygomatic fracture.

Key Words: Facial fracture, fixation, miniplates, zygomatic fracture

Zygomatic bone fractures in 1 piece and that do not require exploration of the zygomatic maxillary suture, can be repaired transcutaneous, including achieving postreduction stability with

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This study was developed in accordance with ethical standards and guided under the Helsinki Declaration of 1964 and its subsequent amendments or comparable ethical standards.

Informed consent was obtained from the participant included in the study. The authors report no conflicts of interest.

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this maneuver alone. Direct percutaneous repositioning of the depressed zygoma can be performed using the Strohmeier¹ or another type of malar hook.² The curved J hook can be inserted through a short incision and positioned on the zygomatic buttress above the fracture and rotated up and to the side. The surgeon uses force and lateral traction under palpation and external inspection of the zygomatic bone, which returns to its correct position, eventually accompanied by a *click* of the bone. In unstable zygomatic fractures, other cutaneous accesses, such as fronto-zygomatic and maxilla-zygomatic, are used for exposure and fixation with miniplates and screws to stabilize the bone. In patients with a history of exuberant scar and with an unstable zygomatic fracture, these percutaneous incisions can trigger an exuberant repair, forming a hypertrophic scar or even a keloid. To avoid undesirable scarring, we use a transconjunctival approach with inclination in the lateral canthotomy whose incision follows the curve of the upper eyelid and which in our view, minimizes the cutaneous signs of this type of surgical access. Tessier³ in 1973 divulged the advantages of this access to reach the orbital floor in patients with congenital or traumatic deformities. Habal and Chaset⁴ described their results in the treatment of 11 patients with floor fractures. They also mention that there is no need for lateral cantotomy, but it would be indicated in cases that require more access due to bone fragmentation of the orbital floor.

TECHNIQUE

Afro-Brazilian male patient was referred for evaluation in an emergency hospital with a history of facial trauma during *capoeira* class. He reported having been hit on the right side of the face by the foot of a rookie. He did not report loss of consciousness was oriented in time and space and did not complain about diplopia, he was evaluated by the neurosurgery team and released. Maxillofacial examination revealed a fracture in a right zygomatic bone. Patient denied systemic pathologies, allergies and after exams and informed consent, after general anesthesia and negative forced duction test were done, the reduction surgery and zygoma fracture fixation were performed by transconjunctival access with right lateral canthotomy that the incision continues the curvature of the upper eyelid (Supplemental Digital Content, Figure 1A and B, <http://links.lww.com/SCS/C849>) added with the use of zygoma reduction hook positioned intraorally at a superior point to the fracture line in the zygomatic buttress (Supplemental Digital Content, Figure 1C, <http://links.lww.com/SCS/C849>). Mini plates were fixed in maxilla-zygomatic suture and in maxillary buttress. Patient involved without complications and the next day was discharged. Patient remained under postoperative control and after 2 years he was revised without esthetic or functional deficits (Supplemental Digital Content, Figure 1D and E, <http://links.lww.com/SCS/C849>).

DISCUSSION

Using this access with modified cantotomy, we achieved the benefits of extending the access to the orbital floor and at the same time preserving the aesthetics, because it camouflages the cutaneous scar, especially in patients with tendencies to form exuberant keloids. Brazilian data indicate that 50% of the population is composed of Afro-Brazilians or pardos (browns).⁵ This multiethnicity makes surgeons look for surgical treatment options that favor aesthetics and, at the same time, allow adequate surgical access and, in our understanding, transconjunctival access following the upper eyelid line meets these requirements and is less visible and remains camouflaged in the line of natural wrinkles in the periorbital region and the hook positioned on the oral mucosa prevents hypertrophic scars that would form on the patient's skin with propensity. Keloids affect individuals with darker skin approximately 15 times more than Caucasians.⁶ In these patients,