ISSN 0973-2063 (online) 0973-8894 (print)

Bioinformation 22(8): 4817-4822 (2026)



BIOINFORMATION
Discovery at the interface of physical and biological sciences

BIOMEDICAL INFORMATICS

www.bioinformation.net
**Volume 22(8)**

**Research Article**

Received August 1, 2026; Revised August 31, 2026; Accepted August 31, 2026, Published August 31, 2026

DOI: 10.6026/973206300224817

SJIF 2026 (Scientific Journal Impact Factor for 2026) = 8.478
2022 Impact Factor (2023 Clarivate Inc. release) is 1.9

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**Edited by Vini Mehta**
**E-mail: vmehta@statsense.in**
**Citation**: Mathar *et al.* Bioinformation 22(8): 4817-4822 (2026)

# Clinical assessment of pontic design in anterior and posterior fixed partial denture patients: A cross-sectional study

**Mohammed Ibrahim Mathar[1,*], Hussain Muaddi Al Hayyah[2], Eman Abdulaziz Alhablen[3], Abdulaziz Waleed Alhazmi[2], Kadi Saleh Alharbi[2], Abdullah Abdulaziz Alhablen[2], Yazid Suliman Alquwayai[2] & Ali Ibrahim Alzaidan[2]**

[1]Department of Prosthetic Dental Sciences, College of Dentistry, Qassim University, Qassim, Saudi Arabia; [2]Department of Prosthetic Dental Sciences College of Dentistry, Qassim University, Qassim, Saudi Arabia; [3]Department of Dental Public Health, College of Dentistry, Qassim University, Qassim, Saudi Arabia; *Corresponding author

**Affiliation URL:**
https://www.qu.edu.sa/en/colleges/dent/

**Author contact:**
Mohammed Ibrahim Mathar - E-mail: m.mathar@qu.edu.sa
Hussain Muaddi Al Hayyah - E-mail: kokm.3.6@gmail.com
Eman Abdulaziz Alhablen - E-mail: 451214470@qu.edu.sa
Abdulaziz Waleed Alhazmi - E-mail: 411107588@qu.edu.sa
Kadi Saleh Alharbi - E-mail: 411201981@qu.edu.sa
Abdullah Abdulaziz Alhablen - E-mail: 391108296@qu.edu.sa
Yazid Suliman Alquwayai - E-mail: 381117535@qu.edu.sa
Ali Ibrahim Alzaidan - E-mail: 411107689@qu.edu.sa

**Abstract:**
While several pontic designs are available in fixed prosthodontics, limited comparative clinical evidence exists regarding surface form, material selection and ridge deformities in anterior and posterior regions. A cross-sectional clinical study was conducted over 18 months on 80 adult patients rehabilitated with short-span (3-unit) FPDs, who were included and divided equally into anterior and posterior groups. A statistically significant association was observed between pontic design and esthetic appearance in the anterior region (p=0.011), with ovate pontics showing superior esthetic outcomes. In the posterior region, pontic design showed a highly significant association with cleansability ($p < 0.001$), with conical pontics exhibiting the most favourable hygiene scores. Thus, pontic design significantly influences esthetics in anterior FPDs and cleansability in posterior FPDs.

**Keywords:** Fixed partial denture; pontic design; ridge deformity; Seibert's classification; esthetics; cleansability

**Background:**
Fixed partial dentures (FPDs) continue to be among the most common restorative treatments for the replacement of missing teeth and, when properly designed, provide predictable results in terms of function, aesthetics and patient comfort. The pontic, a component of the FPD, plays a key role in the success of the prosthesis, biologically, mechanically and aesthetically **[1]**. The primary function of the pontic is to replace the missing tooth but the interaction of the pontic with the underlying ridge and the surrounding soft tissues has a dramatic effect on plaque accumulation, gingival inflammation, ridge preservation, phonetics and the overall longevity of the prosthesis **[2]**. Hence, pontic design has become an essential factor of clinical accomplishment, rather than a mechanical consideration. Despite the existence of several pontic designs, the clinical choice is often empirical and based on the clinician's preference rather than an objective evaluation of the ridge morphology, pontic material and site-specific functional requirements **[3]**. In anterior pontic regions, aesthetics, emergence profile and phonetics are considered important while posterior areas emphasise occlusal stability, load distribution and practicality of hygiene maintenance **[4]**. Moreover, ridge anatomy is of decisive importance for the suitability and performance of a certain pontic design **[5]**. The selection of Pontic material adds a further level of complexity to the clinical decision-making process. Investigations have shown that the material-related determinants can have an effect on gingival health, patient comfort and long-term success of prosthetics, especially in the area of contact between the pontic surface and the residual ridge **[6, 7]**. However, there is little clinical information about pontic design and material with regard to ridge shape and deformities for anterior and posterior short-span FPDs. Many studies have conceptually or in a controlled laboratory setting addressed pontic designs, but still, there is a lack of cross-sectional clinical studies assessing pontic design criteria under real-world circumstances. In particular, the literature is lacking comparative evaluations of pontic surface form, material choice and ridge deformities in anterior and posterior regions. This gap is clinically relevant because sub-optimal pontic design may contribute to plaque accumulation, mucosal inflammation, patient dissatisfaction and reduced prosthesis longevity **[8]**. Therefore, it is of interest to clinically assess the pontic design in the anterior and posterior short-span FPDs by evaluating the pontic surface configuration, pontic material and the effect of residual ridge deformities on clinical outcomes.

**Materials and Methods:**
The present cross-sectional clinical study was conducted to assess the pontic design features in anterior and posterior short-span FPDs according to the pontic design criteria at the outpatient dental clinics of the College of Dentistry, ArRass, Qassim region, Saudi Arabia. The study was conducted for a period of 18 months that included the recruitment of patients, clinical evaluation, data recording and statistical analysis.Ethical approval was obtained from the institutional research ethics committee of the College of Dentistry, ArRass. Written informed consent was obtained from all participants before inclusion. Participant confidentiality was strictly maintained and no identifying information was recorded. Access to the data was restricted to the principal investigator and co-investigators.

**Sample size and grouping:**
A total of 80 adult patients rehabilitated with short-span fixed partial dentures were included in the study. The sample was divided into two groups according to the location of the FPD: Group I(40 patients with posterior short-span (three-unit) FPDs) and Group II(40 patients with anterior short-span (three-unit)

FPDs). All selected FPDs were clinically assessed based on predefined pontic design criteria.

**Sampling technique and study population:**
A non-probability convenience sampling technique was employed. The reference population consisted of adult patients attending the dental clinics, who had been rehabilitated with short-span anterior or posterior fixed partial dentures at the same institution.

**Inclusion and exclusion criteria:**
Patients aged between 20 and 60 years, both male and female, with anterior or posterior short-span (three-unit) FPDs and FPDs supported by either vital or non-vital abutment teeth were included. Patients with long-span FPDs (greater than three units), those with a history of systemic diseases that could influence periodontal or mucosal health, individuals with poorly maintained prostheses and those unwilling to participate were excluded.

**Examiner calibration and reliability assessment:**
Before data collection, calibration was performed by evaluating 10 patients who were not included in the final study sample. The assessments were repeated after a two-week interval to determine intra-examiner reliability.Intra-examiner agreement for pontic design assessment and ridge defect classification was evaluated using Cohen's kappa statistics, which demonstrated satisfactory agreement ($\kappa \geq 0.80$), indicating excellent reliability.

**Data collection methods:**
Data were collected through clinical examination, patient interviews, photographic documentation and functional assessment by the calibrated examiner using standardized diagnostic instruments and procedures. Clinical evaluation included assessment of Pontic surface shape and contour; pontic material; pontic–ridge relationship; presence and type of ridge deformity; functional and hygienic considerations, including patient-reported comfort and ease of cleaning. Standardized intraoral photographs were obtained under uniform lighting conditions to document pontic design and soft tissue contact.

**Assessment of ridge deformities:**
Residual ridge morphology in the pontic area was assessed clinically using a William's periodontal probe to measure ridge height and width. Ridge deformities were classified according to Seibert's classification, as follows: Class I (Buccolingual loss of ridge width with normal ridge height), Class II (Apico-coronal loss of ridge height with normal ridge width) and Class III (Combined loss of ridge height and width). The relationship between ridge deformities and pontic design was recorded separately for anterior and posterior regions.

**Statistical analysis:**
All collected data were recorded in structured data collection forms and entered into IBM SPSS Statistics for Windows, Version 26.0 (IBM Corp., Armonk, NY, USA) for analysis. Descriptive statistics were used to summarize demographic variables and pontic design characteristics. Comparative analyses were performed to evaluate differences between anterior and posterior short-span FPDs. Statistical significance was set at $p < 0.05$.

**Results:**
The study sample consisted primarily of maxillary FPDs (72.5% of cases) and 27.5% were mandibular restorations. The materials most frequently used for pontics were all-ceramic or zirconia restorations (66.3%) and porcelain fused to metal restorations (33.8%). The evaluation of the residual ridge morphology based on Seibert's classification demonstrated that Class III ridge defects were the most frequent (40.0%). Analysis of pontic design showed that the modified-ridge lap design was most frequent (51.2%), followed by conical (21.3%) and full ridge lap (20.0%), while ovate was least frequent (7.5%) **(Table 1)**. The modified-ridge lap pontic was the most common design in the anterior region, primarily made from all-ceramic/zirconia materials (62.5%), with a smaller percentage being porcelain-fused-to-metal (PFM) restorations (12.5%). Ovate and full-ridge lap pontics were used exclusively for all-ceramic/zirconia restorations, with 15.0% and 10.0% of anterior cases, respectively. The chi-square analysis revealed no statistically significant association between pontic design and material type in the anterior region ($\chi 2= 1.905$; $p= 0.386$) **(Table 2)**. The most common design in the posterior region was the conical pontic (42.5%) followed by the full-ridge lap (30.0%) and the modified-ridge lap designs (27.5%). Statistical analysis showed no significant association between pontic design and material type in the posterior region ($\chi^2=1.094$; $p=0.579$), suggesting that the choice of pontic design was not substantially affected by the restorative material in either region. The modified-ridge lap pontic design was the most common in the anterior zone for all ridge categories, with an equal distribution in Class I and Class III defects (27.5%) and a slightly lower incidence in Class II defects (20.0%). Ovate pontics were mostly associated with Class II ridge defects (7.5%), followed by Class I (5.0%) and Class III defects (2.5%), whereas full-ridge lap pontics showed low and relatively uniform distribution over all ridge classes. Conical pontics were the most common type of design in the posterior region in all ridge classifications, particularly in Class III defects (17.5%) followed by Class II (15.0%) and Class I defects (10.0%). Full-ridge lap pontics were more often used for Class III ridge defects (20.0%) than Class I and Class II defects. Modified-ridge lap pontics exhibited a relatively even distribution across ridge classes. The chi-square test indicated no statistically significant association between pontic design and ridge classification in the anterior ($\chi^2=1.944$; $p=0.746$) and posterior ($\chi^2=5.550$; $p=0.235$) regions. In the anterior region, the modified-ridge lap pontic design was the most commonly observed in both arches, with a higher prevalence in the maxillary arch (55.0%) compared to the mandibular arch (20.0%). Ovate pontics were predominantly placed in the maxilla (12.5%), with minimal use in the mandible (2.5%), while full-ridge lap pontics were exclusively observed in the maxillary arch (10.0%). In the posterior region, conical

ISSN 0973-2063 (online) 0973-8894 (print)

Bioinformation 22(8): 4817-4822 (2026) 

pontics were the most frequently used design, particularly in the maxillary arch (37.5%), whereas their use in the mandibular arch was limited (5.0%). Full-ridge lap pontics were equally distributed between the maxillary and mandibular arches (15.0% each), while modified-ridge lap pontics showed a relatively balanced distribution between arches. The chi-square test demonstrated a trend toward significance but did not reach statistical significance for the association between pontic design and arch in the anterior region ($\chi^2$=1.577; p=0.455) and posterior ($\chi^2$=5.849; p=0.054) regions **(Table 3)**. In the anterior region, esthetic outcomes varied significantly according to pontic design. The modified ridge lap pontic demonstrated predominantly good esthetic appearance (57.5%), with a smaller proportion rated as excellent (10.0%) and moderate (7.5%). Ovate pontics showed superior esthetic performance overall, with most cases rated as good (12.5%) and a smaller proportion achieving excellent esthetic appearance (2.5%). In contrast, full ridge lap pontics were more frequently associated with moderate esthetic appearance (7.5%) and demonstrated minimal good esthetic ratings (2.5%). The chi-square analysis revealed a statistically significant association between pontic design and esthetic appearance in the anterior region ($\chi^2$ = 13.014; p = 0.011) **(Table 4)**. In the posterior region, cleansability differed significantly among pontic designs. Conical pontics demonstrated the most favourable cleansability outcomes, with the majority rated as good (32.5%) and a small proportion rated as excellent (2.5%), while none were classified as poor or fair. Modified-ridge lap pontics also proved to be easily cleaned to an acceptable extent, with most of the cases being rated as good (22.5%) and a lesser number rated as excellent (5.0%) and none rated as moderate, poor or fair. However, the cleansability performance of full-ridge lap pontics was more detrimental with moderate (17.5%), poor (7.5%) and fair (2.5%) ratings. Statistical analysis showed a highly significant association between pontic design and cleansability in the posterior region ($\chi$2=27.657; p< 0.001) **(Table 5)**.

**Table 1:** Distribution of FPD characteristics

| Variable | Category | Frequency | Percent |
|---|---|---|---|
| **Arch** | Maxillary | 58 | 72.5% |
| | Mandibular | 22 | 27.5% |
| **Region** | Anterior | 40 | 50.0% |
| | Posterior | 40 | 50.0% |
| **Material** | All ceramic/ Zirconia | 53 | 66.3% |
| | PFM | 27 | 33.8% |
| **Seibert's Classification of Ridge** | Class I | 24 | 30.0% |
| | Class II | 24 | 30.0% |
| | Class III | 32 | 40.0% |
| **Pontic Design** | Modified-ridge lap | 41 | 51.2% |
| | Ovate | 6 | 7.5% |
| | Full-Ridge Lap | 16 | 20.0% |
| | Conical | 17 | 21.3% |

**Table 2:** Pontic design according to material split by region

| Region | Pontic Design | All ceramic/Zirconia (n,%) | PFM (n,%) | Total (n,%) | Chi-Square Tests | p-value |
|---|---|---|---|---|---|---|
| **Anterior** | Modified-ridge lap | 25 (62.5%) | 5(12.5%) | 30(75.0%) | 1.905 | 0.386 |
| | Ovate | 6(15.0%) | 0 (0.0%) | 6(15.0%) | | |
| | Full-Ridge Lap | 4(10.0%) | 0 (0.0%) | 4(10.0%) | | |
| **Posterior** | Modified-ridge lap | 5(12.5%) | 6(15.0%) | 11(27.5%) | 1.094 | 0.579 |
| | Full-Ridge Lap | 4(10.0%) | 8(20.0%) | 12(30.0%) | | |
| | Conical | 9(22.5%) | 8(20.0%) | 17(42.5%) | | |

**Table 3:** Pontic design according to ridge classification and arch split by region

| **Ridge Classification** | | | | | | |
|---|---|---|---|---|---|---|
| **Region** | **Pontic Design** | **Classification** | | | **Chi-Square Test** | **p-value** |
| | | **Class I (n,%)** | **Class II (n,%)** | **Class III (n,%)** | | |
| **Anterior** | Modified-ridge lap | 11(27.5%) | 8(20.0%) | 11(27.5%) | 1.944 | 0.746 |
| | Ovate | 2(5.0%) | 3(7.5%) | 1(2.5%) | | |
| | Full-ridge Lap | 1(2.5%) | 1(2.5%) | 2(5.0%) | | |
| **Posterior** | Modified-ridge lap | 5(12.5%) | 3(7.5%) | 3(7.5%) | 5.550 | 0.235 |
| | Full-ridge Lap | 1(2.5%) | 3(7.5%) | 8(20.0%) | | |
| | Conical | 4(10.0%) | 6(15.0%) | 7(17.5%) | | |
| **Arch Region** | **Pontic Design** | **Arch type** | | | **Chi-Square Test** | **p-value** |
| | | **Maxillary (n, %)** | | **Mandibular (n, %)** | | |
| **Anterior** | Modified-ridge lap | 22(55.0%) | | 8(20.0%) | 1.577 | 0.455 |
| | Ovate | 5(12.5%) | | 1(2.5%) | | |
| | Full-ridge Lap | 4(10.0%) | | 0(0.0%) | | |
| **Posterior** | Modified-ridge lap | 6(15.0%) | | 5(12.5%) | 5.849 | 0.054 |
| | Full-ridge Lap | 6(15.0%) | | 6(15.0%) | | |
| | Conical | 15(37.5%) | | 2(5.0%) | | |

**Table 4:** Pontic design according to esthetic appearance (anterior region)

| Pontic Design | Esthetic Appearance | | | Chi-Square Test | p-value |
|---|---|---|---|---|---|
| | **Excellent (n,%)** | **Good (n,%)** | **Moderate (n,%)** | | |

| | | | | | |
|---|---|---|---|---|---|
| **Modified-ridge lap** | 4(10.0%) | 23(57.5%) | 3(7.5%) | 13.014 | 0.011 |
| **Ovate** | 1(2.5%) | 5(12.5%) | 0(0.0%) | | |
| **Full-Ridge Lap** | 0(0.0%) | 1(2.5%) | 3(7.5%) | | |

**Table 5:** Pontic design according to cleansability (posterior region)

| **Pontic Design** | **Cleansability** | | | | | **Chi-Square Test** | **p value** |
|---|---|---|---|---|---|---|---|
| | **Excellent (n, %)** | **Good (n, %)** | **Moderate (n, %)** | **Poor (n, %)** | **Fair (n, %)** | | |
| **Modified-ridge lap** | 2 (5.0%) | 9 (22.5%) | 0 (0.0%) | 0(0.0%) | 0(0.0%) | 27.657 | <0.001 |
| **Full Ridge Lap** | 0 (0.0%) | 1 (2.5%) | 7 (17.5%) | 3(7.5%) | 1(2.5%) | | |
| **Conical** | 1 (2.5%) | 13(32.5%) | 3 (7.5%) | 0(0.0%) | 0(0.0%) | | |

## Discussion:

The results of the present study showed that maxillary FPDs were more prevalent than mandibular restorations. This is consistent with previous studies **[9, 10]**. The maxillary arch, particularly the anterior portion, impacts more on the smile aesthetics than the mandibular arch. The prominence of the region translates into more rigid aesthetic demands and more frequent prosthetic replacements in the maxilla. In the maxilla, concerns like midline shifts and diastemas are more visible and less acceptable than in the mandible. Maxillary asymmetries are more prominent when the smile and speech are analysed and this underscores the importance of the form, width and palatal contour of the maxillary anterior teeth to achieve the best aesthetics in prosthodontic treatment **[9, 10].** In addition, the balanced anterior and posterior distribution permitted meaningful comparison between region-specific design considerations. The preference for metal-free prostheses has escalated due to better aesthetics, biocompatibility and patient acceptance, resulting in the dominance of all-ceramic and zirconia pontics over PFM restorations **[11].** In our analysis, the evaluation of ridge deformities according to Seibert's classification revealed a higher prevalence of Class III defects, which indicates the presence of both vertical and horizontal ridge loss. This agrees with a previous study that showed advanced ridge resorption after tooth loss, especially in long-term edentulous areas **[12].** There was no statistically significant association between pontic design and ridge classification in the anterior and posterior regions, even in the presence of ridge deformities. This indicates that in clinical practice, the selection of pontic design may be more dependent on operator preference and aesthetic or functional demands than on ridge morphology alone. Johnson and Leary have reported similar observations, emphasising that ridge anatomy is often an overlooked determinative factor in pontic selection **[13].** Analysis of pontic design by material showed no significant association between pontic design and restorative material in anterior and posterior regions. Modified-ridge lap pontics were most often fabricated with all-ceramic or zirconia materials in the anterior region perhaps because of their good aesthetic integration and acceptable tissue contact when contoured properly **[14].** The lack of statistical significance supports the findings of previous studies that pontic design and material selection are often independently decided in routine clinical practice **[14, 15].** Nevertheless, surface finish and polishability rather than material type per se may be more critical in plaque accumulation and tissue response **[16].** Pontic design was significantly associated with aesthetic appearance in the anterior area. Ovate pontics performed better aesthetically, with no cases classified as moderate, confirming their well-documented ability to mimic natural tooth emergence and maintain soft tissue contours **[10].** Modified-ridge lap pontics are the most commonly used design and were rated mostly good than excellent, which indicates an acceptable but not optimal aesthetic outcome. Consistent with the literature reporting compromised emergence profile and increased plaque retention with this design **[15],** full-ridge lap pontics received lower aesthetic ratings. These findings support the current prosthodontic guidelines to use ovate pontics as the design choice in aesthetically demanding anterior regions where ridge conditions permit **[17].** Our results indicated a highly significant association between pontic design and cleansability analysis of the posterior region. The best hygienic results were obtained for conical pontics, followed by modified ridge lap designs, whereas full ridge lap pontics were related to poor to moderate cleansability. These results are consistent with a previous study that showed increased plaque accumulation and mucosal inflammation under ridge-contact pontics with wide tissue contact **[18].** Pontic designs that minimise tissue contact while facilitating interdental cleaning offer clinical advantages in posterior areas with limited visual access and greater plaque challenge. The results of the present study indicate that although modified ridge lap pontics remain the most common design in all regions, their universal application may not always be the most ideal option. The absence of a strong association between pontic design and ridge morphology implies that more attention should be paid to anatomical assessment in treatment planning. However, some limitations should be emphasised before generalising the findings of our study. Cross-sectional design limits causal inference; use of convenience sampling may limit generalisability. Long-term biological outcomes (peri-pontic tissue changes) and patient-reported outcome indicators were not assessed. Further long-term investigations using standardised aesthetic indices, microbiological assessments and patient satisfaction scores should be considered to confirm these findings.

## Conclusion:

Ridge deformities, mainly of Class III, were frequently observed; however, no statistically significant correlation between ridge morphology and the selection of pontic design was found, indicating that anatomical factors may be underemphasised in everyday clinical settings. Ovate pontics were more aesthetically satisfactory in anterior restorations, whereas conical pontics were more cleansable in posterior areas, indicating the importance of pontic design selection according to the region of usage.

**Acknowledgement:**
The authors wish to thank Dr Fawaz Pullisery for his valuable contribution to the statistical evaluation and interpretation of the study data.

**References:**

**[1]** Shrestha L *et al. JNMA J Nepal Med Assoc.* 2020 ***58:*** *15.* [PMID: 32335633]
**[2]** Türp L *et al. J Esthet Restor Dent*. 2025 **37**:969. [PMID: 39462906]
**[3]** Othman MS & Abu-Eittah M.R. *J Contemp Dent Pract*. 2024 **25**:684. [PMID: 39533940]
**[4]** Adurty C *et al. Contemp Clin Dent*. 2020 **11**:101. [PMID: 33110319]
**[5]** Bakshi M *et al. Int J Periodontics Restorative Dent*. 2018 **38**:541. [PMID: 29889919]
**[6]** Alenezi A & Alsahi H. *J Prosthet Dent*. 2025 **135**:552e1. [PMID: 41176440]
**[7]** Aldowish AF *et al. Cureus*. 2024 **16**:e73195. [PMID: 39651022]
**[8]** Koeppe S *et al. J Adhes Dent*. 2025 **27**:163. [PMID: 40996132]
**[9]** Kuruhan MS & Buyukbayraktar Z.C. *Am J Orthod Dentofacial Orthop*. 2025 **167**:425. [PMID: 39708003]
**[10]** Carneiro DPA *et al. Am J Orthod Dentofacial Or*thop. 2022 **161**:390. [PMID: 34688516]
**[11]** Ispas A *et al. Biology (Basel)*. 2022 **11**:556. [PMID: 35453755]
**[12]** Sykes LM *et al. S Afr Dent J*. 2021 **76**:545. [DOI: 10.17159/2519-0105/2021/v76no9a5]
**[13]** Johnson GK & Leary JM. *Dent Clin North Am*. 1992 **36**:591. [PMID: 1397427]
**[14]** Wan J *et al. World J Clin Cases*. 2021 **9**: 11276. [PMID: 35071558]
**[15]** Gomez-Meda R & Esquivel J. *J Esthet Restor Dent*. 2023 **35**:609. [PMID: 36708252]
**[16]** Dutra D *et al. Oper Dent*. 2018 **43**:E37. [PMID: 29284102]
**[17]** Agarwal S *et al. Cureus*. 2025 **17**:e80276.[PMID: 40201882]
**[18]** Bukhari MA *et al. Int J Community Med Public Health*. 2022 **9**: 4725. [DOI: 10.18203/2394-6040.ijcmph20223238]