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**THE RELATIONSHIP BETWEEN THE SEVERITY OF MALOCCLUSION  
AND GINGIVAL STATUS IN STUDENTS OF SMPN 5 MARABAHAN**

**Akhmad Aufayed Ma'rifatullah<sup>1)</sup>, Diana Wibowo<sup>2)</sup>, Aulia Azizah<sup>3)</sup>**

<sup>1)</sup>Faculty of Dentistry, Lambung Mangkurat University, Banjarmasin, Indonesia

<sup>2)</sup>Department of Orthodontics, Faculty of Dentistry, Lambung Mangkurat University, Banjarmasin, Indonesia

<sup>3)</sup>Department of Dental Public Health, Faculty of Dentistry, Lambung Mangkurat University, Banjarmasin, Indonesia

**ABSTRACT**

**Background:** South Kalimantan experienced dental and mouth problems with a prevalence of 59,6%, so did Barito Kuala Regency with 68,66%. Malocclusion is a dental and oral health problem related to the disharmony between jaws and teeth. Many cases of malocclusion occur in children aged 12-14 years by 15,6% in the form of crowded teeth in South Kalimantan. Malocclusion is a factor that can cause food debris to stick to the interdental area between the crowded teeth, thus forming plaque accumulation. Plaque is the primary etiological factor that influences gingival status. **Objective:** This study aimed to determine the relationship between the severity of malocclusion and gingival status in students aged 12-14 years at SMPN 5 Marabahan. **Method:** This study used analytic survey research with cross sectional research design. The research population was all students of SMPN 5 Marabahan aged 12-14 years who born in March 2005 - January 2008, amounting to 88 people. The minimum sample size which determined by the proportion estimation formula was 47 people. The used sampling technique was simple random sampling technique with inclusion and exclusion criteria. **Results:** The distribution frequency of the study showed mild malocclusion of 55,3% and mild inflammation of 57,4%. Spearman analysis test results on the severity of malocclusion based on Mal I and gingival status based on GI showed a significance value of  $p = 0,045$  ( $p < 0,05$ ). **Conclusion:** It could be concluded that there was a relationship between the severity of malocclusion and gingival status in students aged 12-14 years at SMPN 5 Marabahan.

**Keywords:** Gingival Index, Gingival Status, Malalignment Index, Malocclusion, Permanent Tooth Occlusion Stage 2.

**Correspondence:** Akhmad Aufayed Ma'rifatullah; Faculty of Dentistry, Lambung Mangkurat University, Jl. Bumi Mas 2 No. 28, Banjarmasin 70249, South Kalimantan; E-mail: [aufayedayed@gmail.com](mailto:aufayedayed@gmail.com)

**INTRODUCTION**

South Kalimantan experienced dental and mouth problems with a prevalence of 59,6%, so did Barito Kuala Regency with 68,66%. Malocclusion is a dental and oral health problem whose prevalence ranks third after caries and periodontal disease.<sup>1,2</sup> Malocclusion is a condition associated with disharmony between jaws and teeth.<sup>3</sup> The last 2013 report showed that the cases of malocclusion in children aged 12-14 years were 15,6% in the form of crowded teeth in South Kalimantan Province.<sup>4</sup>

Occlusion that deviates from the normal position can be determined in various ways, one of which is by using Malalignment Index (Mal I). It is a simple, objective, and practical occlusion

assessment standard based on the irregularity of the position of the teeth in the form of tooth rotation and deviation from labiolingual.<sup>5</sup>

Malocclusion is one of the factors that make it difficult to brush teeth. Difficulties in brushing teeth cause food debris that sticks to the interdental area of crowded teeth are not easy to reach, thus forming plaque accumulation. Plaque is a primary etiological factor that influences gingival status, such as gingivitis and, even, other periodontal tissue damage.<sup>6</sup> Research by Rauten *et al* found that 65,62% of 204 children aged 7-19 years with crowded teeth and diastema suffered from gingivitis.<sup>7</sup>

Gingival inflammatory conditions in individuals and groups can be assessed using the Gingival Index (GI). This index classifies the

severity of gingival inflammation based on color, texture, contour, adhesion, and ulceration of the gingiva.<sup>8,9</sup>

The 2018 Riskesdas showed that only 6.42% of the people in Barito Kuala Regency received counseling about taking care of their dental and oral health and hygiene.<sup>1</sup> SMPN 5 Marabahan is a junior high school in Barito Kuala Regency that is located  $\pm$  2,5 km from the nearest community health center (Puskesmas). A preliminary survey in 15 students showed that they experienced malocclusion in their anterior teeth.

Based on the description above, the researchers were interested in conducting a study on "The Relationship of the Severity of Malocclusion and Gingival Status in Students Aged 12-14 Years at SMPN 5 Marabahan" due to the need for further research of the preliminary study at the school. Besides, the researchers also realized that there was still a lack of counseling and data regarding malocclusion and gingival status in children aged 12-14 years in South Kalimantan.

## RESEARCH METHOD

The research began with the preparation of a research permit and the ethical clearance issued by Faculty of Dentistry of Lambung Mangkurat University No.058/KEPKG-FKGULM/EC/I/2020. The method used in this study was analytic survey research with cross sectional research design. The research population was all students in SMPN 5 Marabahan aged 12-14 years that was born in March 2005 - January 2008, amounting to 88 people. The minimum sample size which determined by the proportion estimation formula was 47 people. The sampling technique used was simple random sampling technique with inclusion and exclusion criteria. The inclusion criteria were included: 1) Parents had signed informed consent and allowed their children to be examined; 2) Students who experienced malocclusion with labiolingual deviation and tooth rotation, and; 3) Students had teeth 16, 21, 24, 36, 41, and 44. The exclusion criteria were included: 1) Students who were in fixed orthodontic treatment; 2) Students who did not want to be examined or those who were not cooperative, and; 3) The conditions of students suddenly did not support during impression and examination.

The research was conducted at SMPN 5 Marabahan located on Jalan Gawi Sabumi, Marabahan District, Barito Kuala Regency, South Kalimantan from January 2020 to March 2020. Tools used included: dental mirror, WHO probes, impression trays, alginate spatulas, rubber bowls, Malalignment Index, plastic rulers, beaker glass,

informed consent sheet with approval sheet, and Mal I and GI examination sheets. Materials used include: surgical masks, handschoens, alginates (GC Aroma Fine Plus Normal setting), gypsum type III (Montano), and 70% alcohol.

The independent variable in this study was the severity of malocclusion based on the Malalignment Index (Mal I), while the dependent variable was the gingival status based on the Gingival Index (GI). The severity of the malocclusion was measured using a 1 x 4-inches plastic ruler, the edge of which was tilted at 45° and the other end was marked with horizontal and vertical lines at a distance of 1.5 mm from the edge of the top. The teeth assessed were divided into 6 (six) segments. The score of each segment was obtained by summing the scores of each tooth with the following scoring criteria:

Score 0 = The teeth are regular in a normal row.

Score 1 = The teeth are mildly irregular with a rotation of  $<45^\circ$  or displacement of  $<1,5$  mm.

Score 2 = The teeth are severely irregular with a rotation of  $\geq 45^\circ$  or a displacement of  $\geq 1,5$  mm.

Each score per segment was summed and determined by each individual severity criteria as follows:

1-6 = Very mild malocclusion

7-12 = Mild malocclusion

13-18 = Moderate malocclusion

$>18$  = Severe malocclusion

Gingival status assessment was done by inserting the tip of the probe with a light pressure of 10-20 grams in the gingival sulcus. The assessed gingival sulcus consists of facial/buccal, mesial, distal, and lingual/palatal parts. The teeth assessed were those according to index criteria, consisting of teeth 16, 21, 24, 36, 41, and 44.

The level of inflammation and the presence of bleeding were scored ranging from 0 to 3 with the following scoring criteria:

Score 0 = No inflammation, discoloration, or bleeding.

Score 1 = There are slight changes in color and edema, but there is no bleeding on probing.

Score 2 = There are redness, shiny color, edema, and bleeding on probing.

Score 3 = There are bright redness, clearer edema, ulceration, and spontaneous bleeding.

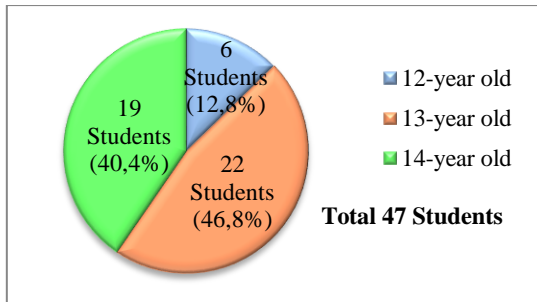
The gingival score per tooth could be determined by summing the scores of all four tooth areas and then divided by 4. Individual scores could be determined by summing the scores of each tooth and then divided by 6. Individual GI criteria could be determined as follows:

- 0 = Healthy gingiva
- 0,1 - 1,0 = Mild inflammation
- 1,1 - 2,0 = Moderate inflammation
- 2,1 - 3,0 = Severe inflammation

The results of the malocclusion severity assessment and gingival status in the SMPN 5 Marabahan students were analyzed. The analysis was performed using a nonparametric test, which is the Spearman test, with the help of the SPSS program. Both variables had a significant relationship if the *p*-value is < 0,05.

**RESULTS**

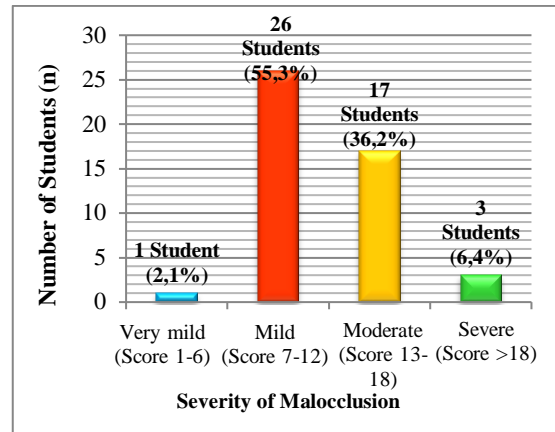
The following are the results of research on respondents in students aged 12-14 years at SMPN 5 Marabahan. The description of the respondents would be presented in a diagram by age, severity of malocclusion, and gingival status. The research results were then analyzed, as presented in the table.



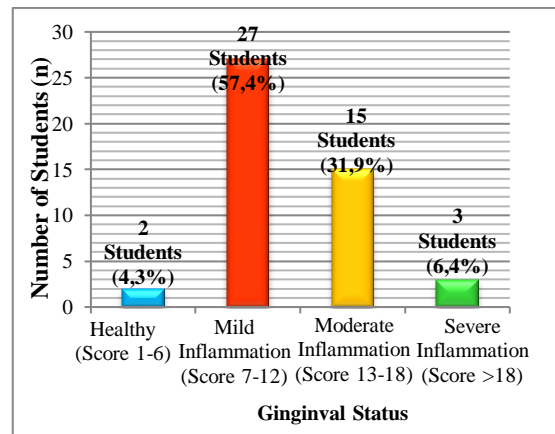
**Figure 1.** Research Respondent Characteristics by Age in Students Aged 12-14 Years at SMPN 5 Marabahan.

The characteristics of research respondents, based on age was shown in Figure 1, total of 47 students. Most respondents were children aged 13 years, with a percentage of 46,8% among students at SMPN 5 Marabahan.

The distribution frequency of malocclusion severity was shown in Figure 2. It was obtained from the assessment results based on Mal I on the students' jaw models. Most students examined experienced mild malocclusion, which was in 26 students (55,3%) of 47 respondents aged 12-14 years at SMPN 5 Marabahan.



**Figure 2.** Distribution Frequency of the Severity of Malocclusion based on Malalignment Index (Mal I) for Students Aged 12-14 Years at SMPN 5 Marabahan.



**Figure 3.** Distribution Frequency of the Gingival Status based on Gingival Index (GI) for Students Aged 12-14 Years at SMPN 5 Marabahan.

**Table 1.** The Distribution Frequency of the Malocclusion Severity against Gingival Status in Students aged 12-14 years at SMPN 5 Marabahan.

Variable	Status Gingiva (n)				Total
	Healthy (Score 0)	Mild Inflammation (Score 0,1-1,0)	Moderate Inflammation (Score 1,1-2,0)	Severe Inflammation (Score 2,1-3,0)	
Very Mild (Score 1-6)	0 Students	1 Students	0 Students	0 Students	1 Students
Mild (Score 7-12)	1 Students	18 Students	6 Students	1 Students	26 Students
Moderate (Score 13-18)	1 Students	7 Students	8 Students	1 Students	17 Students
Severe (Score >18)	0 Students	1 Students	1 Students	1 Students	3 Students
<b>Total</b>	<b>2 Students</b>	<b>27 Students</b>	<b>15 Students</b>	<b>3 Students</b>	<b>47 Students</b>

The distribution frequency of the gingival status was shown in Figure 3. It was obtained from the results of the assessment based on GI in the students' oral cavity. The most gingival status found was in the category of mild inflammation, as many as 27 students (57,4%) of 47 respondents.

Table 1 shows the distribution frequency of the severity of malocclusion against gingival status in 47 students at SMPN 5 Marabahan. Students who experienced mild malocclusion with mild gingival inflammation category were the most common with 18 students aged 12-14 years.

**Table 2.** Statistical Analysis of the Relationship between the Severity of Malocclusion and Gingival Status.

	Severity of Malocclusion	Variable
*Significance	0,045*	Gingival Status
Correlation coefficient	0,293	

The results of the Spearman analysis test based on table 2 showed that the relationship between the severity of malocclusion based on Mal I and gingival status based on GI had a value of  $p = 0,045$  ( $p < 0,05$ ). The correlation coefficient obtained was  $r = 0,293$  and was positive.

## DISCUSSION

Respondents obtained in Figure 1 are 47 students who have experienced irregularities and rotations of the teeth. These results were consistent with research by Rahman *et al* who found that 50% of 40 respondents had experienced malocclusion in the forms of crowded teeth in students in SMPN 14 Yogyakarta.<sup>10</sup> Cases of crowded teeth can be characterized by irregularities in the position of the teeth, including

teeth that are not located in the dental arch and rotated teeth.<sup>6</sup>

Figure 1 shows that most of respondents were 13-year-old children, as many as 22 students (46,8%) of 47 respondents at SMPN 5 Marabahan. Respondents were obtained based on inclusion criteria by sampling probability techniques. Sample criteria help researchers reduce bias results.<sup>11</sup> One of the probability sampling techniques is simple random sampling which is a way to select randomly without paying attention to the strata of the population.<sup>12</sup>

12-14 years is the age at which stage 2 of the development of permanent teeth occlusion occurs. Permanent teeth occlusion stage 2 occurring at the age of 10-14 years is characterized by the replacement of the primary molars and canines by permanent premolars and canines that will achieve maximum occlusion. Permanent teeth at this stage may still experience changes or malocclusion. Changes or malocclusions that can occur are in the form of crowded teeth on the anterior especially the lower jaw. Permanent teeth can grow crowdedly due to the mandibular rotation, dentoalveolar adaptation, posterior dental movement to mesial, and the size of teeth larger than the dental arch.<sup>13,14</sup>

Figure 2 shows that the severity of malocclusion was mostly in the category of mild malocclusion, 26 students (55,3%) These results were different from the research conducted by Dayataka *et al.* that found malocclusion categorized as very severe in 41% of 61 students at SMPN 1 Cimahi.<sup>15</sup>

The different percentages of malocclusion categories were related to the common factor causing malocclusion, namely the difference in modern diets/eating patterns between in the village and in the city. The preliminary study depicted the location of SMPN 5 Marabahan and showed that

most students were living in rural areas. The research showed that junior high school students in urban areas were 12,5% more likely to consume fast food such as Junk Food in the category of 1 time a day or 4-6 times a week than those in rural areas.<sup>16</sup>

Modern diets encourage humans to eat soft and fast food, which will cause a lack of masticatory movements, thus causing a lack of stimulus to the jaws. It causes the growth of the jaw and the dental arch space to be reduced, leading to crowding.<sup>13,17</sup> Hard or rough food eating patterns on the other hand, will require strong mastication to stimulate facial bone growth especially in the transverse dimensions of the maxilla and mandible. This statement is also supported by the presence of Aboriginal groups in Australia who eating rough food, resulting in reduced mesiodistal tooth width. So, the dental arch length can be reduced by around 2-3 mm and reducing the tendency of teeth to grow crowdedly.<sup>14,17</sup>

Figure 3 shows that the most common gingival status was mild inflammation, 27 students (57,4%). Lesar *et al* did research in SMP Advent Watulaney in Minahasa Regency and found the same results. They found that 41,27% of 63 students aged 12-14 years had mild inflammation of their gingiva.<sup>18</sup>

Gingival inflammation is caused by an increase in the level of pathogenic bacteria such as *Actinomyces*, *Capnocytophaga*, *Leptotrichia*, and *Selenomonas subgingiva*. These pathogenic bacteria are often present in children or adolescents.<sup>19,20</sup> Another factor, such as puberty, can also contribute to gingival inflammation. The age of puberty that occurs in adolescents is the age at which increased hormone gland activity occurs, so that the hormones estrogen, progesterone, and androgens will increase sharply.<sup>21</sup> Increased hormones will change the response of vascular and inflammation of the periodontal tissue directly to local factors such as reactions to microbes in plaque accumulation. This response will produce an anatomical change such as inflammation that is relatively mild to gingiva.<sup>20,22</sup>

Malocclusion also has a relationship to the occurrence of dental caries and periodontal problems.<sup>13</sup> Table 1 shows that the most common distribution is students who experienced mild category of malocclusion with gingival status in the category of mild inflammation. The total of students in these two categories was 18 students. This description is similar to the results of a study by Sasea *et al* conducted on 62 students of Dentistry Study Program at Sam Ratulangi University. They found 23 respondents who had

crowded tooth abnormalities had mild inflammation on their gingivae.<sup>6</sup>

Table 2 shows a significant relationship between the severity of malocclusion based on Mal I and gingival status based on GI because the value of  $p = 0.045$  ( $p < 0.05$ ). Javali *et al* obtained similar results with this study with value  $p = 0,046$  from variations in malocclusion to the occurrence of gingival inflammation in patients at one of the universities in Saudi Arabia.<sup>23</sup> The level of strength of the relationship between the two variables is sufficient and unidirectional because the  $r$  value is more than 0,25 but less than 0,5 and is positive value.<sup>24</sup> Therefore, it could be interpreted that the more severe the severity of malocclusion based on Mal I, the more severe the gingival status based on GI.

Gingival inflammation occurs due to a primary causative factor namely bacterial plaque. Malocclusions such as irregular tooth position are a predisposing factor for gingival inflammation as shown in Tables 1 and 2 of this study. This predisposing factor will complicate the control of plaque and the maintenance of oral hygiene from food debris when brushing teeth especially in the interdental area. The irregular position of teeth can indirectly facilitate the formation of a greater accumulation of certain bacterial flora of dental plaques, thereby increasing the occurrence of gingival inflammation.<sup>6,25</sup>

This study had several limitations in the form of the Mal I index which can only assess malocclusions on teeth with labiolingual and rotational irregularities. The GI index which can only be done by probing, which allow the gingiva to be irritated. Also, this study did not identify and control other factors that could influence such as diet and tooth brushing behavior. Based on the results of this study, it could be concluded that there is a relationship between the severity of malocclusion and gingival status in students aged 12-14 years at SMPN 5 Marabahan. The strength level of the relationship is sufficient and unidirectional, so that the more severe the malocclusion, the more severe the gingival status.

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