

## THE RELATIONSHIP OF THE LEVEL OF MALOCCLUSION SEVERITY BASED ON THE ICON (INDEX OF COMPLEXITY, OUTCOME AND NEED) WITH THE RISK OF CARIES JUDGED FROM THE PLAQUE ATTACHMENT IN ADOLESCENTS AT TABANAN

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### ABSTRACT

Malocclusion is a frequent problem that can be found at the oral and dental health care. Individual's abnormal teeth condition with malocclusion can become a risk to caries, this condition happen because of difficulty to clean teeth mechanically when brushing teeth. This study trying to find the correlation between orthodontic treatment need with risk of caries. This research is an analytical observational research with a cross sectional study design. The sampling process was done by using multistage random sampling which taken from seventh, eighth, and ninth class of the SMP N 2 Marga (Junior High School). Total number of samples are 90 people with same distribution for each class. Orthodontic treatment need can be measured by ICON (Index of Complexity, Outcome and Need) and risk of caries can be determined by GC Tri Plaque ID Gel that applied for all samples. Statistic hypothesis of this study tested using non parametric test such as Spearman Rank Correlation. The results showed that samples that did not need orthodontic treatment experienced low caries risk (36%), moderate caries risk (13%) and high caries risk (0%). Samples that included borderline cases experienced low caries risk (11%), moderate caries risk (15%) and high caries risk (0%). Samples requiring orthodontic treatment experience low caries risk (1%), moderate caries risk (10%) and high caries risk (4%). Statistical analysis showed correlation coefficient of 0.585, there was a relationship between the orthodontic treatment need with caries risk, with a value  $p = 0,000$  which means there is a significant relationship between orthodontic treatment need with the risk of caries.

**Keywords :** Malocclusion, ICON, Caries Risk

### INTRODUCTION

Malocclusion is a condition related to irregularities in the arrangement of the teeth in the jaw arch. According to Ardhani et al (2014), malocclusion is a dental and oral health problem whose incidence rate ranks third after caries and periodontal disease.<sup>1</sup> In Indonesia, the prevalence of malocclusion in adolescents in 1983 was 90% and in 2018 it was 80%.<sup>2</sup> Carlos et al. (2015) stated that the risk of caries is directly proportional to the severity of the malocclusion, where respondents with severe malocclusion have a 31% greater chance of suffering from caries.<sup>2</sup> Malocclusion conditions can be evaluated using ICON (Index of Complexity, Outcome and Need). The advantage of ICON is that it is easier to use, practical, and measures relatively few properties.<sup>3,4</sup>

Accurate examination of malocclusion using ICON can be carried out from the age of 12 years, because at that age permanent tooth occlusion has already been formed, and can still get maximum results until the age of 15 years.<sup>5</sup> In conditions of malocclusion, plaque will easily form due to the difficulty of removing plaque. mechanically by brushing your teeth, thereby increasing the risk of caries. The risk of caries can be determined by examining the duration of plaque attachment using GC Tri

Plaque ID Gel (Satariah, 2008).<sup>6</sup> Individuals with a high risk of caries have a longer duration of plaque attachment compared to individuals who have a low risk of caries or caries-free. This condition is caused because the longer plaque is attached to the teeth, the lower the pH of the plaque will be, causing a mineralization process on the tooth surface which ends in caries. Based on the description above, the aim of this study is to determine the relationship between the severity of malocclusion and the risk of caries in adolescents aged 12-15 years at SMP N 2 Marga Tabanan.

### MATERIALS AND METHOD

This research is a type of analytical observational research with a cross-sectional design. Sample selection was carried out using a multistage random sampling technique in classes VII, VIII and IX at SMP N 2 Marga. The entire research sample consisted of 90 people with the same sample distribution at each grade level. The sample criteria are: adolescents aged 12-15 years, in the permanent dentition stage, all teeth with normal crown morphology (no conditions that can change the mesio-distal or bucco-lingual width, such as restorations or large caries involving the mesio-lingual aspect distal or bucco-lingual, attrition or

fracture), have no history of or are currently undergoing orthodontic treatment.

**Construction of Study Models**

A study model of the upper and lower jaw was made using alginate impression material and cast with type 2 plaster and a base was made with type 1 plaster.

**Bite Registration**

Cut a sheet of red wax 7 cm long and 1.5 cm wide, then pass the wax sheet over the bunsen until it feels slightly hot. The wax sheet is then placed over the occlusal of the right lower jaw posterior teeth, then instruct the subject to centric occlude (previously the subject was taught the correct way to centric occlude), remove the wax sheet from the oral cavity and store it in a bag filled with cold water.

**Taking Buccal Retracted Photograph in a State of Occlusion**

Photographs of the sample's teeth were taken by positioning the sample as best as possible with the respondent's head facing forward, then taking a photograph, the resulting photograph must be symmetrical to the midline of the face, and parallel to the occlusal plane.

**Measurement of Plaque Attachment Time using GC Tri Plaque ID Gel**

GC Tri Plaque ID Gel is applied to the entire surface of the sample's teeth, then waited for 1 minute, then the sample is instructed to rinse the mouth for 30 seconds, the dominant color change interprets the risk of caries.

**Table 1.ICON ASSESMENT SCORE<sup>9</sup>**

Occlusal Features	Score (mm)						Total Score
	0	1	2	3	4	5	
1. Aesthetic components	Skor: 1, 2, 3, 4, 5, 6, 7, 8, 9 ,10						7
2. Crowding in Maxilla	< 2	2,1-5	5,1-9	9,1-13	13,1-17	>17 or impacted tooth	5
Diastema in Maxilla	< 2	2,1-5	5,1-9	> 9			5
3. Crossbite	No	Crossbite					
4. Anteroposterior relationship of buccal segment	Crossbite Cusp to Embrasure relationship (Class I, II, III)	Relationship of other cusps except cusp-to-cusp	Relationship of cusps to cusps				3
5. Anterior vertical relationship open bite	Edge to edge	< 1	1,1-2	2,1-4	> 4		4

**ICON Measurement (Index of Complexity, Outcome and Need)<sup>7,8</sup>**

a. Retrieval of Aesthetic Component Data

The photos taken of each sample were compared with the 10 grade aesthetic components on ICON.

b. Collecting Data on Maxillary Crowding or Diastema

Maxillary crowding or diastema was measured by the Lundstrom method. After measurements are taken, the six segments are then added together. This value is compared with the mesial distal size of 12 teeth from the left to right first permanent molars. The difference between the two, shows the state of the remaining room. Note: The score recorded is the highest score for both diastema and crowding

c. Crossbite Data Retrieval

Crossbite is observed by occluding the upper and lower jaw study models, then seeing whether there is a crossbite.

d. Retrieval of Anterior Vertical Relation Data

Anterior openbite was measured vertically at the incisors of the upper and lower incisors using calipers. Note: The score recorded is the highest score, both openbite and overbite

e. Retrieval of Data on Anteroposterior Relations of the Buccal Segment

The anteroposterior relationship of the buccal segment is measured by assessing the anteroposterior relationship of the canines, premolars and molars (cusp to embrasure relationship, other cusp relationships, or cusp to cusp relationship).

Overbite	Covers < 1/3 lower incisors teeth	Covers 1/3-2/3	Covers > 2/3	Covers All	4
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**TOTAL**    28

**Table 2.**Categories of Orthodontic Treatment Needs<sup>7</sup>

Category	Score
<input type="checkbox"/> Does not require treatment	< 31
<input type="checkbox"/> Borderline case	31-42
<input type="checkbox"/> <b>Needs Treatment</b>	> 43

**Table 3.**Severity of Malocclusion<sup>7</sup>

Severity level of malocclusion	Score
<input type="checkbox"/> Easy	< 29
<input type="checkbox"/> Mild	29-50
<input type="checkbox"/> Moderate	51-63
<input type="checkbox"/> Difficult	64-77
<input type="checkbox"/> <b>Very Difficult</b>	> 77

**1. RESULTS**

**Table 4.**Distribution of Research Sample's Characteristic

Research Sample Characteristic	Frequency		Percentage
		(f)	(%)
Gender	Male	44	48,9
	Female	46	51,1
Age	12 years	13	14,4
	13 years	40	44,4
	14 years	34	37,8
	15 years	3	3,3
<b>Total</b>		90	100

**Table 5.** Distribution of Research Sample based on the Severity Level of Malocclusion

Malocclusion Severity	Frequency	Percentage
	(f)	(%)
<i>Easy</i>	44	48,9
<i>Mild</i>	38	42,2
<i>Moderate</i>	6	6,7
<i>Difficult</i>	2	2,2
<i>Very Difficult</i>	0	0
<b>Total</b>	90	100

**Table 6.** Distribution of Research Sample based on Caries Risk

Caries Risk	Frequency	Percentage
	(f)	(%)
Low	48	53,3
Moderate	38	42,2
High	4	4
<b>Total</b>	90	100%

**Table 7.** Distribution of Research Sample based on Orthodontic Treatment Needs

Orthodontic Treatment Needs	Frequency	Percentage
	(f)	(%)
Does not need treatment.	46	51,1
Borderline Case	24	26,7
Needs treatment	20	22,2
<b>Total</b>	90	100

**Table 8.** Relationship Between Gender and Severity Level of Malocclusion

Gender	Severity of Malocclusion				Total	p-Value
	Easy	Mild	Moderate	Difficult		
Male	15	22	5	2	44	0,018
	34,1%	50%	11,4%	4,5%	100%	
Female	29	16	1	0	46	
	63%	34,8%	2,2%	0%	100%	
Total	44	38	6	3	90	
	48,9%	42,2%	6,7%	2,2%	100%	

**Table 9.**Relationship Between Gender and Caries Risk

Gender	Caries Risk			Total	p-Value
	Low	Moderate	High		
Male	21	20	3	44	0,404
	47,7%	45,5%	6,8%	100%	
Female	27	18	1	46	
	58,7%	39,1%	2,2%	100%	
Total	48	38	4	90	
	53,3%	42,2%	4,4%	100%	

**Table 10.**Relationship Between Malocclusion Severity and Caries Risk

Age	Caries Risk			Total	rho	p value
	Low	Moderate	High			
12 years	11	2	0	13	0,170	0,108
	86,6%	15,4%	0,0%	100%		
13 years	19	19	2	40		
	47,5%	47,5%	5,0%	100%		
14 years	17	15	2	34		
	50%	44,1%	5,9%	199%		
15 years	1	2	0	3		
	33,3%	66,7%	0,0%	100%		
Total	48	38	4	90		
	53,3%	42,4%	4,4%	100%		

**Table 11.**Relationship Between Age and Caries Risk

Severity of Malocclusion	Caries Risk			Total	rho	p value
	Low	Moderate	High			
Easy	35	9	0	44	0,585	0,000
	79,5%	20,5%	0,0%	100%		
Mild	13	25	0	38		
	34,2%	65,8%	0,0%	100%		
Moderate	0	4	2	6		
	0,0%	66,7%	33,3%	100%		
Difficult	0	0	2	2		
	0,0%	0,0%	100%	100%		
Total	48	38	4	90		
	53,3%	42,2%	4,4%	100%		

## DISCUSSION

The severity of malocclusion as measured using ICON in this study shows that the severity of malocclusion is more towards the easy level, namely 44 people (48.9%), followed by the mild level of 38 people (42, 2%), and the moderate level was 6 people (6.7%), the smallest number was at the difficult level, 2 people (2.2%) and none of the samples experienced malocclusion at the very difficult level. This condition is not much different from the results of research conducted in the cities of Ventspils and Riga.

Research conducted in the city of Ventspils with a smaller sample size, namely 48 teenagers with an age range of 12 to 17 years, showed that the severity of malocclusion was easy 34%, mild 40%, moderate 14%, difficult 7%, and very difficult 2%. Meanwhile, in research conducted in the city of Riga with a larger sample size, the results were not much different, from 149 teenagers aged 12 to 18, the severity of malocclusion was easy 37%, mild 44%, moderate 15%, difficult 1% and no one experienced malocclusion with a severity level of very difficult.<sup>8</sup> This shows that the severity level of malocclusion in teenagers is predominantly at the severity level of easy and mild, followed by the severity level of moderate, and only a small percentage experienced the severity level of difficult or even very difficult.

Based on gender, as shown in Table 8., it shows that girls are more dominant in experiencing malocclusion at the easy severity level, namely 63%, while boys are more dominant in experiencing malocclusion at the mild severity level, namely 50%. In addition, malocclusion with difficult severity is only experienced by boys. This condition shows that boys have a higher level of severity of malocclusion than girls, with the results of statistical analysis showing that there is a significant relationship between gender and the severity of malocclusion. This is in line with research conducted by Kusuma et al., which found that the percentage of severe malocclusions between boys and girls was 72% versus 44%.

One of the factors that causes girls to have malocclusion with a lower severity than boys is parental factors. According to Kusuma et al., parents tend to pay more attention to the dental and oral health of their daughters compared to their sons from when they were little.<sup>9,10</sup> Yaghma (2013), also revealed a similar thing, where parents had more dental treatment for their daughters compared to sons. This condition is caused by parents paying more attention to the aesthetic condition of their daughters than sons. So that local etiological factors of malocclusion such as caries or trauma to deciduous teeth receive more treatment in girls. Treatment of caries and trauma to deciduous teeth can simultaneously prevent premature loss of deciduous teeth, which is also one of the local factors that cause malocclusion. Another local factor that can cause malocclusion is the persistence of deciduous teeth. It was found that persistent deciduous teeth receive more treatment in girls.<sup>10-12</sup> Treatment of these conditions will certainly be a preventive measure against the occurrence of malocclusion in permanent teeth.

The relationship between gender and caries risk, which is described in Table 9, shows that girls predominantly experience low caries risk (58.7%), followed by medium caries risk (39.1%) and high caries risk (2.2%). Meanwhile, boys have a low and moderate caries risk with percentages that are not much different, namely 47.7% and 45.5%, followed by a high caries risk, namely

6.8%. The results of these measurements show that boys are more at risk of experiencing caries, although the results of statistical tests show that there is no significant relationship between gender and the risk of caries.

The low risk of caries in girls is related to girls' desire to always appear in their best physical condition when socializing with their peers. Meanwhile, boys usually act more indifferent or pay less attention to appearance.<sup>4</sup> According to Louwse (2005), there is a concept of need, which explains that a person takes care because of awareness and psychosocial changes in himself who want a more attractive appearance, especially when it comes to women.<sup>5,11</sup> The results of Satariah's (2008) research also show a similar thing, where there is a relationship between gender and quality of life.<sup>6</sup> The results of this research show that girls are more sensitive to changes in their lives, compared to boys, such as things which concerns aesthetics including dental health care.

The risk of caries based on age as described in Table 10, shows that samples aged 12 years mostly experience low caries risk. Samples aged 13 years experienced low and moderate caries risk with the same percentage. Samples aged 14 years mostly experienced low caries risk, while samples aged 15 years mostly experienced moderate caries risk. However, the high caries risk was only experienced by samples aged 13 and 14 years. A high risk of caries was not found at the age of 15 years, this is possibly because the number of samples aged 15 years in this study was too small, namely only 3 people. However, this condition still shows a tendency for caries risk to increase with increasing age, although the results of statistical analysis show that there is a very weak and insignificant relationship between age and caries risk. This condition can be explained by the theory that with increasing age, the teeth will be exposed longer in the mouth, making them more likely to experience caries.<sup>12</sup> Caries takes a long time to develop, not days or weeks but months or years. This is supported by research conducted by Hafez et al which states that the prevalence of caries in children with malocclusion is lower than in adults who also experience malocclusion.<sup>13,14</sup>

The relationship between the severity of malocclusion and the risk of caries can be seen in Table 11., where malocclusions with the severity level of easy most often experience low caries risk. Malocclusions with mild severity have the highest risk of moderate caries. Likewise, malocclusion with moderate severity is most likely to experience moderate caries risk. Meanwhile, malocclusions with a difficult severity level all experience a high risk of caries. The results of statistical analysis also show that there is a significant relationship between the severity of malocclusion and the risk of caries, where the strength of the relationship is moderate. Several malocclusion conditions such as crowding of teeth have an influence on the incidence of caries in permanent teeth. The condition of crowded teeth causes food to get stuck between the teeth and is difficult to clean. This will continue until the remaining food is accumulated by bacteria into plaque which is even more difficult to clean. Plaque that is not cleaned on the surface of the teeth will cause the formation of caries or cavities.<sup>15,16</sup> Other conditions such as anterior open bite can also cause caries. A person with this condition tends to breathe through the mouth and this causes a decrease in saliva flow. A dry mouth due to decreased saliva flow can make it easier for cariogenic microorganisms that cause caries to reproduce.<sup>17-19</sup>

Temporo Mandibular Disorders (TMD) are also a malocclusion condition that can cause caries. Several people in the sample who experienced malocclusion in the research conducted by Marquezan also complained of TMD. TMD can cause chewing disorders on one side of the jaw which can lead to caries on the non-chewing side.<sup>20,21</sup> Teeth on the jaw side that do not carry out chewing activities will experience a decrease in the flow of saliva which will cause the teeth to be susceptible to caries.<sup>13</sup> Malocclusion is also closely related to periodontal disease. Abnormalities in the vertical and horizontal relationships of the upper and lower anterior teeth, shifting of the teeth, and abnormalities in the occlusion of the posterior teeth can cause periodontal tissue damage, which can cause caries in the cervical area of the teeth.<sup>22</sup>

Apart from showing the severity of malocclusion and caries risk, this study also explains the level of need for orthodontic treatment in the study sample. Most of the samples (51.1%) in this study did not require orthodontic treatment, followed by borderline cases at 26.7% and those requiring orthodontic treatment were only 22.2%. This condition is caused by the majority of samples experiencing malocclusion with easy and mild severity levels and only a small number of samples experiencing malocclusion with moderate and difficult severity levels.

However, there are several things that need special attention, as stated by Richmond et al. who stated that the initial use of orthodontic index depended on the principle that patients should receive orthodontic treatment if they really need treatment on an objective basis. Richmond et al., also illustrate that this opinion is too simplistic because the patient may need orthodontic treatment, but the severity of the malocclusion is mild.<sup>23</sup> This statement is in accordance with the results of this study, there were several cases that included mild severity of malocclusion, but the level of need for treatment included group requires care. This condition occurs because in ICON, the aesthetic component gets a very high proportion of value.<sup>24</sup> The reason is none other than because orthodontic treatment is mostly carried out to improve the appearance of the patient's teeth, so assessment of the aesthetic component is the most important. Therefore, in the future use of ICON, researchers really need to provide an objective assessment of the aesthetic component so as not to influence the final results of the assessment with this index, although sometimes the assessment of the aesthetic component even among orthodontists often differs.<sup>25,26</sup>

Apart from providing enormous value to the aesthetic component, ICON also has the weakness of only assessing how much space is lacking and cannot assess conditions caused by lack of space, such as tooth rotation or migration.<sup>27</sup> Apart from that, ICON also doesn't use cephalometric analysis in assessing the condition of malocclusion or in considering the need for treatment.<sup>28</sup>

The limitations of this research were other factors such as consumption of cariogenic foods, level of knowledge about dental and oral health and dental care behavior were not studied so the pure influence related to the risk of caries cannot be known.

## CONCLUSION AND SUGGESTION

Based on the description described above, it can be concluded that there is a moderate relationship between the severity of malocclusion and the risk of caries ( $r = 0.585$ ) and is statistically significant ( $p = 0.000$ ).

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