

# Comparative Analysis of Two Methods for the Assessment of Aesthetic Impairment Involving Teeth

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## Abstract

**Objective:** To analyze and compare the effectiveness of two methods designed for the assessment of esthetic impairment in patients with missing teeth. **Material and Methods:** Two methods were addressed in this study: 7-level scale (7LS) and AIPE-Odonto/Brasil. Both tools are designed to assess esthetic dental impairment in civil and criminal Courts. One-hundred and thirteen dentists used the tools to assess dental esthetic impairment in four mock cases (one male and three females). The outcomes of their analyses were compared with pre-established gold-standard scores. Chi-square test was used to investigate the influence of dentists' sex, age, time of experience and forensic knowledge with their outcomes. **Results:** Dentists' outcomes were closer to the expected gold-standard scores when AIPE-Odonto/Brasil was used compared to 7LS ( $p < 0.05$ ). Dentists' sex, time of experience and forensic knowledge were significantly associated with the scores obtained with both tools ( $p < 0.05$ ). **Conclusions:** Comparatively, AIPE-Odonto/Brasil was more effective for the assessment of esthetic dental impairment involving missing teeth compared to the 7LS.

## Keywords

Dental Esthetics, Wounds and Injuries, Trauma, Forensic Dentistry, Facial Injuries

## 1. Introduction

The assessment of esthetic impairment involving teeth and permanent esthetic deformity varies in concept and method worldwide, considering the whole body,

the face or just the teeth. The advantage of using these two protocols and more specifically AIPE-Odonto/Brasil is the establishment of fairer more uniform indemnities. In civil and criminal Courts forensic reports often lack information about the characterization of dental trauma and the inherent assessment of esthetic impairment what, actually, may lead to wrongful decisions [1] [2]. In the Brazilian context, this occurs more often due to the lack of protocols standardization (civil Courts) and in the criminal Courts, besides the existence of standardized protocols, dental aspects are commonly neglected once, instead of dental surgeons, physicians perform the exams. Considering not only legal aspects related to professional boundaries between dental surgeons and physicians on countries where dentistry and medicine are independent professions, dental surgeons are naturally those professionals that act on the lower face and oral cavity and so are supposed to be more qualified to perform assessment of facial and oral esthetic impairment.

Knowledge of the trauma and its impact in victim's physical and psychological health is essential to reach optimal performances during the assessment of esthetic dental impairment. Several variables can influence this process, especially victim's health and esthetic status before the trauma [3] [4] [5].

However, the most important drawback in assessing esthetics is the subjectiveness that surrounds the characterization of pre- and post-traumatic changes that result from missing teeth. Specific methods were designed to make the assessment more objective. These methods are founded on the effects of the esthetic impairment over the examiner and the respective quantified scores. The 7-level scale (7LS) [6] and the Instrument for the Analysis of Esthetic Impairment Impression (AIPE-Odonto/Brasil) [7] figure as tools that enable a quantified assessment of esthetic dental impairment. The scientific literature shows that both methods broadly used worldwide, but were never addressed together in a comparative study involving dental trauma.

This study aimed to perform a comparative analysis of the effectiveness of 7LS and AIPE-Odonto/Brasil in mock situations that portrait civil and criminal cases of esthetic impairment after dental trauma.

## **2. Material and Methods**

### **2.1. Study Design**

An observational cross-sectional study was performed in the interface of esthetic and forensic dentistry. Institutional ethical clearance was obtained from the local committee of ethics in research (protocol: 56988016.9.0000.0075).

Two methods designed for the analysis of esthetic impairment were used, namely the 7LS and the AIPE-Odonto/Brasil [5]. The first, relies on a 7-level scale of esthetic impairment divided into very mild (1/7), mild (2/7), moderate (3/7), medium (4/7), important (5/7), very important (6/7) and extremely important (7/7) [6]. The second consisted of an adapted version previously validated in Portuguese for the Brazilian population applicable to assess esthetic

dental impairment [7] (Table 1 and Table 2). In a comparative approach, both methods were investigated based on their effectiveness to quantify esthetic dental impairment. One-hundred and thirteen dentists (66.4 females and 33.6% males), aged between 20 and 40 years, were recruited for this study. Dentists with less than 5 years of experience accounted for 42.5%, dentists with experience between 5 and 15 years accounted for 33.6%, and dentists with more than 15 years of experience reached 23.9%. Dentists with forensic knowledge represented 59.3% of the sample. The participants were requested to apply the two methods in four mock cases of victims that lost their maxillary anterior teeth after trauma. Dentists' scores within each method were compared with pre-established and expected gold-standard scores. Additional analyses were performed to test the influence of dentists' sex, age, time of experience and forensic knowledge on their scores.

**Table 1.** Questions provided to the examiners as initial approach to assess esthetic dental impairment with AIPE-Odonto/Brasil.

Questions to be answered by the examiner:	Answers (checkbox):
<b>1. Level of evidence</b>	
To what extent the esthetic alteration is visible?	<input type="checkbox"/> not detectable
(Consider as parameters the exposure of incisors, the perception of the dental arch, and the exposure of the gingiva while smiling).	<input type="checkbox"/> detectable
	<input type="checkbox"/> clearly detectable
<b>2. Tendency of looking straight to the alteration</b>	
Is the esthetic alteration causing fixation of the examiner that prevents him/her to look away?	<input type="checkbox"/> alterations is not looked with fixation
(Consider looking as a natural behavior without inhibition. The examiner must get rid of any conditioning (e.g. education and compassion) that prevents him to report answer for this question).	<input type="checkbox"/> fixed looking to the alterations
	<input type="checkbox"/> do not remember
<b>3. Level of memory regarding the alteration</b>	<input type="checkbox"/> remember
When the patient is remembered, how can you describe the alteration?	<input type="checkbox"/> causes important memory and the memory can be used to describe the patient
<b>4. Level of emotion</b>	<input type="checkbox"/> does not trigger emotions
Does the alteration trigger any emotion? (e.g. sadness)	<input type="checkbox"/> triggers emotions
→ <b>Classification as permanent esthetic impairment* (deformity):</b>	
Do you consider it as a serious esthetic alteration capable of reducing considerably the victim's general esthetics and triggering humiliation and sadness?	<input type="checkbox"/> no
	<input type="checkbox"/> yes
<b>5. Type of emotion</b>	<input type="checkbox"/> does not affect relationship
If you are close (relative or not) to the victim, do you think the esthetic impairment could affect your personal relation with her?	<input type="checkbox"/> could affect the relationship superficially
	<input type="checkbox"/> could affect the relationship deeply

\*The concept of permanent esthetic impairment is based on the Brazilian Legislation<sup>4</sup>. For application elsewhere, this tool should be revised and validated.

**Table 2.** Translation of the answers in **Table 1** provided to the examiners as second and final step to assess esthetic dental impairment with AIPE-Odonto/Brasil.

**Translate the answers previously provided in Table 1 to find the severity level of the esthetic dental impairment**

Severity level	Level of esthetic impairment	1. Level of evidence	2. Tendency of looking straight to the alteration	3. Level of memory regarding the alteration	4. Level of emotion	5. Type of emotion
0	Not relevant	Not detectable [ ]				
1	Mild	Detectable [ ]	Alteration is not looked with fixation [ ]			
2	Moderate	Clearly detectable [ ]	Fixed looking to the alteration [ ]	Does not remember [ ]		
3	Medium	Clearly detectable [ ]	Fixed looking to the alteration [ ]	Remember [ ]	Does not trigger emotions [ ]	
4	Important	Clearly detectable [ ]	Fixed looking to the alteration [ ]	Causes important memory and the memory can be used to describe the patient [ ]	Triggers emotions [ ]	Does not affect relationship [ ]
			→ Permanent aesthetic impairment (deformity)	no [ ] yes [ ]		
5	Very important	Clearly detectable [ ]	Fixed looking to the alteration [ ]	Causes important memory and the memory can be used to describe the patient [ ]	Triggers emotions [ ]	Could affect the relationship superficially [ ]
6	Extremely important	Clearly detectable [ ]	Fixed looking to the alteration [ ]	Causes important memory and the memory can be used to describe the patient [ ]	Triggers emotions [ ]	Could affect the relationship deeply [ ]

**AIPE-Odonto/Brasil—Supplementary criteria that could increase the severity level of alteration\* and that must be considered for esthetic dental impairment:** a) The alteration is detectable within a range of 90 - 130 cm; b) The alteration is detectable during conversation; c) The alteration rises the attention during intimate relationship (kisses); d) The alteration is detectable during routine functional activities, such as smiling and yawning; e) The alteration is detectable in victim's workplace. \*The supplementary criteria do not have specific guidelines for their application. The examiner must use common sense during the assessment and must consider the consequences of the alteration to the victim.

## 2.2. Mock Case Set Up

Four patients (one male and four females) aged between 20 and 50 years old were selected and signed informed consent forms to participate in this study. The rationale behind sampling was justified by the fact that these patients were awaiting oral rehabilitation with implants and prostheses at the institutional

dental center. Photographs were taken from each patient before rehabilitation to simulate a post-traumatic condition that resulted in anterior tooth loss ( $n = 2$ ) and complete tooth loss in the maxilla ( $n = 2$ ). After rehabilitation, photographs were taken in the same position to simulate the victim's condition before the trauma. Image sets up from each patient included photographs in frontal, angular and lateral views and in frontal close-up of the smile (**Figure 1**). The distance between patient and camera was 127 cm. All the photographs were taken in standing position with an EOS D700 camera (Canon, Tokyo, Japan) equipped with 100/35mm lens and ring flash (Canon, Tokyo, Japan). Camera settings were 1/60s of exposure and 5.6 opening [8].

With the same camera, videos were recorded from each patient in order to enable a dynamic analysis of their speech considering words that involve interaction between tongue, lips and teeth [8]. Next, videos were made to record patients smiling and yawning. Dynamically, the camera moved from frontal to lateral view covering a 90° range.

### 2.3. Training

Prior to the assessment of the esthetic impairments, the examiners were exposed to videos [9] [10] that provided reference information about the application of the two methods in practice. The video balanced the judgment between examiners and contributed to a more standardized assessment.



**Figure 1.** Photographs of the four cases in frontal view simulating situations before (BT) and after trauma (AT) presented to the examiners.

## 2.4. Pairing Scales

Based on the structural differences between the two scales used in this study, pairing was justified to make them more compatible and comparable. In particular, the only discrepant level between scales consisted of “very mild” (in 7LS) which is absent in AIPE-Odonto/Brasil. Hence, for methodological purposes, this level was excluded (**Table 3**). Examiners’ performance was founded on correct (identical to the gold standard), overvalued and undervalued answers.

## 2.5. Setting the Gold-Standard

The gold-standard score was established in each case by trained examiners. All the cases were scored as “important”—level 5 in 7LS and level 4 in AIPE-Odonto/Brasil. The following supplementary criteria were considered for the assessment: 1) being detectable within a range [11] of 90 - 130 cm, 2) being detectable during conversation, 3) rising the attention during intimate relation (e.g. kissing), 4) if not naturally visible (e.g. missing teeth), being detectable during smiling or yawning, 5) being related with the victim’s labor activities (e.g. communication at work). The gold-standard was set based on static (photographic) and dynamic (video and speech) evidences.

## 2.6. Statistic Analysis

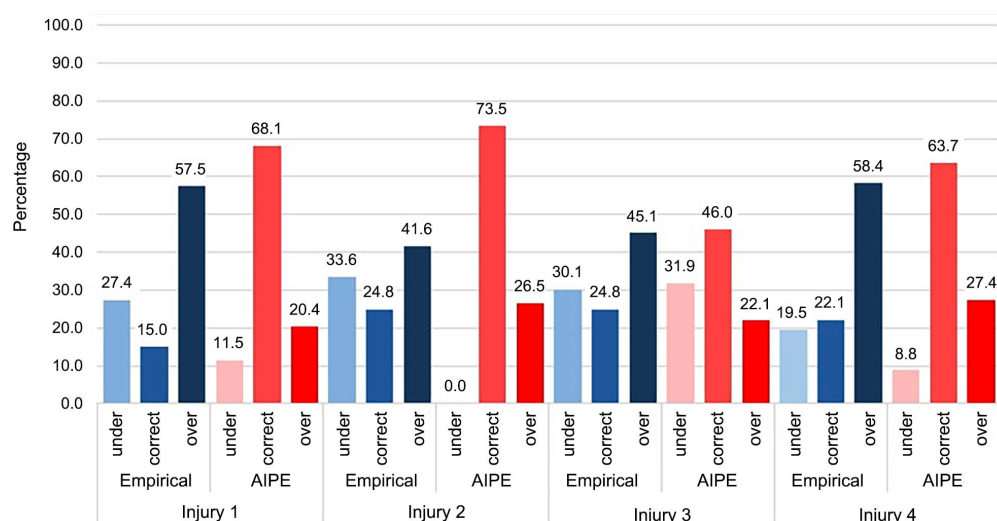
Data was analyzed both for the individual score to each esthetic dental impairment, as well as for the association between dentists’ score and the gold-standard. Chi-square test was used to test the influence of sex, age, time of experience and forensic knowledge on examiners’ scores (SPSS 22.0, IBM Corp. Armonk, USA). Significance level was set at 5% and confidence level at 95%.

## 3. Results

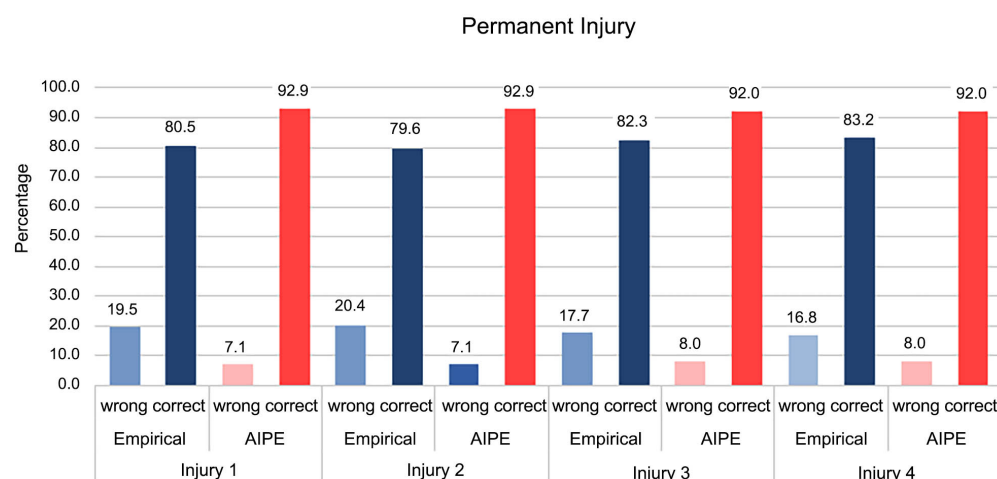
**Figure 2** shows the comparison between dentists’ scores and the gold standard score. Statistically significant differences were observed between methods depending on the assessed injury ( $p < 0.05$ ). Regarding the classification of injuries as permanent esthetic dental impairments (deformity), all the victims were properly classified in both methods (**Figure 3**).

**Table 3.** Methods paired based on their severity scale.

7-level Scale	AIPE-Odonto/Brasil	Paired scale
Level 1—Very mild	-	-
Level 2—Mild	Level 1—Mild	Mild
Level 3—Moderate	Level 2—Moderate	Moderate
Level 4—Medium	Level 3—Medium	Medium
Level 5—Important	Level 4—Important	Important
Level 6—Very important	Level 5—Very important	Very Important
Level 7—Extremely important	Level 6—Extremely important	Extremely important



**Figure 2.** Percentage of correct, overvalued and undervalued answers for 7LS (empiric) and AIPE-Odonto/Brasil methods comparing dentists' scores and the gold-standard.



**Figure 3.** Percentage of correct answers for 7LS (empiric) and AIPE-Odonto/Brasil methods classifying each injury (from 1 to 4) as permanent aesthetic dental impairment (deformity).

The comparison between methods using the total scores ( $n = 452$ ) resulted in statistically significant differences ( $p = 0.000$ ) between dentists' scores. 7LS scores were overvalued in 50.4% of the sample and correctly addressed in 27.7%, while AIPE-Odonto/Brasil reached 57.3% of correct answers.

**Table 4** shows that examiners' sex was associated with correct answers ( $p = 0.000$ )—using 7LS method men had better performance; while the opposite was found in AIPE-Odonto/Brasil, in which women were better. Age was significantly associated with age only in 7LS method, in which older examiners (41 - 56 years) had a higher frequency of correct scores, while young examiners overvalued most of the injuries (70.7%). In AIPE-Odonto/Brasil method, statistically significant results were not found ( $p < 0.05$ ). Time of experience played a significant part in association with the performance of the examiners in both methods. Using 7LS and AIPE-Odonto/Brasil, examiners with less time of experience

since undergraduation reached the highest frequencies of correct answers: 43.8% and 68.8%, respectively. Forensic knowledge also had statistically significant association with the performance of the examiners in reaching correct answers. Examiners with less knowledge of forensics answered correctly more frequently.

**Table 4.** Global distribution of scores and independent variables between methods and in comparison with the gold-standard.

Examiner		Independent variable	Correct	Undervalued	Overvalued	N	Pearson Chi-Square value
		<b>Overall scores 7LS</b>	21.9%	27.7%	50.4%	452	66.961
		<b>Overall scores AIPE-Odonto/Brasil</b>	57.3%	18.6%	24.1%	452	0.000
Sex (7LS)	Female	% Within Female -> (100%)	17.3%	24.7%	58.0%	300	21.486
	Male	% Within Male -> (100%)	30.9%	33.6%	35.5%	152	0.000
Sex (AIPE)	Female	% Within F	61.0%	14.7%	24.3%	300	9.515
	Male	% Within M	50.0%	26.3%	23.7%	152	0.009
Time of experience (7LS)	<1 Year	% Within <1 Year	43.8%	6.3%	50.0%	16	29.41
	1 - 5 years	% Within 1 - 5 years	14.6%	27.4%	58.0%	212	
	6 - 10 years	% Within 6 - 10 years	16.7%	33.3%	50.0%	72	
	11 - 15 years	% Within 11 - 15 years	31.8%	25.0%	43.2%	44	0.001
	16 - 20 years	% Within 16 - 20 years	37.5%	20.8%	41.7%	48	
Time of experience (AIPE-Odonto/Brasil)	<1 Year	% Within <1 Year	68.8%	31.3%	0.0%	16	20.663
	1 - 5 years	% Within 1 - 5 years	60.8%	14.6%	24.5%	212	
	6 - 10 years	% Within 6 - 10 years	54.2%	13.9%	31.9%	72	
	11 - 15 years	% Within 11 - 15 years	59.1%	29.5%	11.4%	44	0.024
	16 - 20 years	% Within <1 Year	50.0%	18.8%	31.3%	48	
Forensic Knowledge (7LS)	No	% Within no Forensic Knowledge	28.8%	31.0%	40.2%	184	14.421
	Yes	% Within Forensic Knowledge	17.2%	25.4%	57.5%	268	0.001
Forensic Knowledge (AIPE-Odonto/Brasil)	No	% Within no Forensic Knowledge	59.2%	26.1%	14.7%	184	21.074
	Yes	% Within Forensic Knowledge	56.0%	13.4%	30.6%	268	0.000



## 4. Discussion

Understanding personal judgment of beauty requires a deep knowledge of brain dynamics and response to esthetic stimuli [10] [12] [13]. Anatomically, the initial formation of negative esthetic impression is associated with the right orbito-frontal cortex [14]. The abstract impression of esthetics is subjective. Research in the field of Orthodontics showed that no objective measurement of the teeth could predict an esthetic smile after treatment [15]. In Implantology, authors investigated and compared eight objective measurements to assess esthetics [16]. Statistically significant differences occurred between measurements regarding their reliability and validity. In short, the objective approach to assess esthetics after oral rehabilitation did not reflect the subjective opinion of patients [17].

The present study used the AIPE-Odonto/Brasil and the 7LS scales because the former addresses a more cognitive structure to assess esthetic dental impairment, while the latter is empiric and relies on the description of the injury.

In practice, esthetic dental impairment can lead to several consequences. In particular, missing teeth and adjacent alveolar bone contribute to a more aged face and directly influence on esthetics. The consequences may be even worse if affecting specific professionals, such as artists and teachers. The importance of dental esthetics is highlighted in a descending order from the anterior region of the mouth (incisors and canines) to the posterior region (premolars and molars). Moreover, maxillary teeth have more esthetic importance than mandibular teeth [18].

The quantification of esthetic impairment in specific forensic services, such as in Brazil, does not have a standard protocol to uniformly guide practices in Civil and Criminal Courts. Some researchers [5] claim that the use of instruments for the quantification of esthetic impairment may support forensic practices with more objective performances; however they may not translate the severity of the impact of the esthetic impairment in the victim's life. In addition, to reduce esthetic dental impairment, restorations or prostheses can be proposed as appropriate, as well as reviewing the use of the tables proposed in the method, and also, if the tooth has already been treated, carry out an assessment focused on functionality and disability.

AIPE-Odonto/Brasil was adapted from the original [3] Spanish version by removing two tables. The modification was established because the removed tables consisted of procedures to quantify the damage in indemnity values. In Brazil, forensic experts are restricted by Law to reporting the severity of the injury, while the indemnity values are calculated by the Magistrate. The simplified version of this tool was validated in Portuguese for application in Brazil [7]. Other modifications included questions specifically designed for dental/mouth impairment. **Table 1** exemplifies the modification pointing out guidelines for the examiner: "Consider as parameters the exposure of incisors, the perception of the dental arch, and the exposure of the gingiva while smiling". This technical input drives the examiners to take into account dental and labial characteristics

of the victims in the beginning of the assessment of esthetic impairment [19]. Gingival exposure is also addressed in the previous guideline. In practice, the examiners must verify if balance exists between the exposed proportions of gingiva and teeth within victim's smile [20].

The comparison between scores in both methods showed that, in all the four cases, AIPE-Odonto/Brasil reached higher frequency of correct answers. Differently, 7LS methods showed tendency for overvalued scores (**Figure 2**). It may be justified by the lack of objective parameters to support the examiners and the lack of full-body photographs. **Table 4** highlights the greater performance of AIPE-Odonto/Brasil, not only for correct answers (in relation to the gold standard), but also the reduction of overvalued frequencies (which were significantly higher in 7LS).

In criminal forensic practice, the most frequent dental injuries, such as fractures and avulsion, are interpreted as being present or not present, while under civil aspects the esthetic dental impairment degree must be quantified [2]. In order to standardize the forensic practice, AIPE-Odonto/Brasil not only addresses both parameters, but also includes the concept of permanent esthetic dental impairment (deformity) [4]. This specific type of injury is characterized by triggering emotional response in the examiner and manifest humiliation or sadness in the victim.

The Brazilian Law characterizes bodily injury crime as an offense or aggression to someone's body integrity or health. The penalties are ranked according to the outcomes of the injury to the victim. Dental injuries are frequent [21] and their consequences are often discussed in the forensic community because of the inherent subjectiveness. The method based on level deepening (detection, looking, remembering, and emotioning) is able to decrease subjectiveness. However, while questioning the presence of permanent deformity, a small difference (13%) was found between methods (**Figure 3**). In this item, AIPE-Odonto/Brasil revealed more correct answers.

Statistical analyses (**Table 4**) showed that examiners' sex was associated with correct answers (Chi-square test,  $p < 0.05$ ). Performing 7LS method men had better adherence to Golden Standard (males 31% vs. females 17%); while the opposite was found in AIPE-Odonto/Brasil, in which women performed better (females 61% vs. males 50%). Globally these outcomes may be related to the fact the three out of four victims addressed in this study were women. Anyway, sex discrepancies considering correct, undervalued and overvalued were significantly minor under AIPE-Odonto/Brasil.

Forensic knowledge also had statistically significant association with the performance of the examiners. Although examiners with less forensic knowledge performed better in both methods, again, the discrepancies were minor under AIPE-Odonto/Brasil.

It is important to note that AIPE-Odonto/Brasil outcomes ranged between undervaluation, correct and overvaluation, and that better outcomes were ex-

pected within this methods based on the previous statistical findings. In this context, the analysis of esthetics approached with AIPE-Odonto/Brasil enables an interpretation and better understanding of the situations even for those outside the health sciences. Consequently, it may improve judgments and mediation in Court [22].

Examiners experience (years of dental practice after graduation) was also significantly associated with correct answers (Golden Standard adherence). Performing 7LS method, with the exception of newly graduated examiners (n16) who have had the highest frequency of correct scores (43.8%), there was an increase of correct scores along professional experience time. The same consideration can be extracted from AIPE-Odonto/Brasil, analysis, but for better, the discrepancies related to correct, undervalued and overvalued were minor than those observed when performing 7LS method.

Other methods for the assessment of esthetic dental impairment exist. The *Psychosocial Impact of Dental Aesthetics Questionnaire (PIDAQ)* figures among those validated in Brazil [23]. However, this method is based on self-perception and is not used in the forensic scenario because it tends to overvalue the injuries in favor of the victim most of the time.

The esthetic impairment and the permanent deformity involving teeth may have consequences that extend to different senses—especially auditory, justified by the modified speech, and visual, justified by the lack of teeth while speaking, smiling and yawning. Future studies in the field should address functional impairment and the inherent sequels of the injury to the victims. Tools, such as the International Classification of Functioning, Disability and Health may support these investigations, mainly in cases of highly severe injuries with functional impairment.

Finally, this study, as many others in the field of esthetic impairment, relies on mock cases and simulations. This restriction is necessary to scientifically perform according to ethical and legal standards. The comparison between simulated circumstances before and after trauma also emerged as a restriction because it lacks information of the trauma itself and of the natural morphology of the teeth before trauma—potentially hampering proper judgments.

## 5. Conclusion

The comparative analysis between AIPE-Odonto/Brasil and 7LS (empiric) revealed that the former reached better outcomes compared to the pre-established gold-standard. Both methods showed statistically significant associations with examiners' sex, time of experience since undergraduation and forensic knowledge/affinity.

## Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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