



**UNIVERSIDADE ESTADUAL DE CAMPINAS  
FACULDADE DE ODONTOLOGIA DE PIRACICABA**

**LÍDIA ALMEIDA LIMA DE CASTRO**

**ESTIMATIVA DE IDADE EM INDIVÍDUOS VIVOS:  
CARACTERÍSTICAS E CASUÍSTICA**

**ESTIMATION OF AGE IN LIVING INDIVIDUALS:  
CHARACTERISTICS AND CASUISTRY**

Piracicaba  
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Dissertação apresentada à Faculdade de Odontologia de Piracicaba, da Universidade Estadual de Campinas, como parte dos requisitos exigidos para a obtenção do Título de Mestre em Biologia Buco-Dental, com concentração em Odontologia Legal e Deontologia.

*Dissertation presented to the Piracicaba Dental School of the University of Campinas in partial fulfillment of the requirements for the degree of Master in Buco-Dental Biology, in Forensic Dentistry and Deontology area.*

Orientadora: Prof<sup>a</sup>. Dr<sup>a</sup>. Ana Cláudia Rossi

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## RESUMO

A estimativa da idade em vivos tem como objetivo avaliar o processo de desenvolvimento e maturação física, esquelética e dentária, por meio de métodos e técnicas específicas para esclarecimento de casos cíveis, criminais e administrativos. O objetivo da pesquisa foi realizar um estudo retrospectivo, analisando relatórios de exames periciais de estimativa de idade realizados em indivíduos vivos no Instituto de Medicina Legal de Porto Velho, Rondônia, Brasil, visando avaliar a quantidade e as características dessas perícias, incluindo a análise dos métodos utilizados durante o exame e os fundamentos utilizados pelos peritos para concluir os relatórios. Para a análise retrospectiva foi realizado um estudo transversal, com base em registros e laudos de exames forenses de estimativa de idade realizados em indivíduos vivos, realizados no Instituto de Medicina Legal de Porto Velho, Rondônia, Brasil no período de janeiro de 2013 e dezembro de 2019. Dentre os 271 relatórios selecionados, foi possível observar que a perícia estava relacionada à área criminal em apenas seis casos (2,21%), a maioria dos quais foi solicitada para fundamentar ações cíveis (97,79%). Foi evidenciado elevado número de exames de estimativa de idade em indivíduos vivos na região amazônica do Brasil, especialmente vinculados a casos civis, e em adultos e idosos. Foi possível destacar a importância de um exame clínico minucioso de todo o corpo, com observação de caracteres macroscópicos relacionados ao crescimento e envelhecimento, associados ao exame clínico dos dentes, com a devida e criteriosa análise da história clínica, principalmente quando houver a ausência de exames radiográficos, o que impede a aplicação de métodos mais precisos. O exame radiológico deve ser realizado sempre que disponível, pois é o método que confere maior precisão às análises.

**Palavras-chave:** Antropologia forense. Odontologia legal. Determinação da idade pelo esqueleto. Determinação da idade pelos dentes. Estimativa de idade em vivos.

## **ABSTRACT**

The age estimation in living aims to assess the process of physical, skeletal, and dental development and maturation, through specific methods and techniques to clarify civil, criminal and administrative cases. The aim of this study was to carry out a retrospective study, analyzing the reports of age estimation tests performed on living individuals at the Institute of Legal Medicine of Porto Velho, Rondônia, Brazil, seeking to assess the quantity and characteristics of these forensics, including the analysis of methods used during the examination and the fundamentals used by the experts to conclude the reports. For the retrospective analysis, a cross-sectional study was carried out based on records and reports of forensic examinations of age estimation performed on living individuals, examined at the Institute of Legal Medicine of Porto Velho, Rondônia, Brazil in the period between January 2013 and December of 2019. Among the 271 selected reports, it was possible to observe that the expertise was related to criminal proceedings in only six cases (2.21%), most of which were requested to substantiate civil proceedings (97.79%). A high number of age estimation tests was evidenced in living individuals in the Amazon region of Brazil, especially linked to civil cases and in adults and elderly. It was possible to highlight the importance of a thorough clinical examination of the whole body, with observation of macroscopic characters related to growth and aging, associated with the clinical examination of the teeth, with due and careful analysis of the case history, especially when there is a lack of radiographic examinations prevent the application of more accurate methods. The radiological examination must be carried out whenever available, as it is the method that gives more precision to the analyses.

**Keywords:** Forensic anthropology. Forensic dentistry. Age determination by skeleton. Age determination by teeth. Age estimation in living.



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## 1 INTRODUÇÃO

Os peritos forenses odontologistas realizam diversos tipos de análises relacionadas ao seu campo de atuação, incluindo as perícias de identificação de cadáveres, a análise de lesões traumáticas presentes no complexo bucomaxilofacial e os exames de estimativa de idade em indivíduos vivos (Solon, 2008).

A perícia de estimativa de idade em vivos visa avaliar o processo de desenvolvimento e maturação física, esquelética e dentária, por meio de métodos e técnicas específicas com o propósito de esclarecer casos civis, criminais e administrativos (Black, Aggrawal and Payne-James, 2010). Constitui um dos exames mais complexos durante a atuação pericial forense, pois a impossibilidade de usar métodos invasivos, que consomem tecidos humanos ou que demandam extração de dentes reduz a gama de estudos que podem ser usados na análise e torna o processo mais delicado (Jeevan *et al.*, 2011).

Além disso, o desenvolvimento, o crescimento e o envelhecimento são influenciados por diversos fatores, como fatores genéticas, diferenças entre grupos populacionais, nutrição, ação hormonal, doenças, estilo de vida, status socioeconômico e fatores ambientais (Black, Aggrawal and Payne-James, 2010; De Luca *et al.*, 2010). Em crianças e subadultos, observa-se um menor grau de erro no que concerne à estimativa de idade, devido à baixa variabilidade individual de características morfológicas do desenvolvimento ósseo e dentário, os quais ocorrem dentro de padrões previamente conhecidos (De Luca *et al.*, 2010). Porém, o fim do crescimento e do desenvolvimento dos tecidos humanos que ocorre por volta dos 20 a 25 anos de idade diminui os caracteres disponíveis para avaliação etária e reduz a exatidão dos métodos que podem ser usados em adultos e idosos, já que o envelhecimento é bem mais variável e menos previsível que o desenvolvimento humano. Quanto mais velha a pessoa, maior pode ser a discrepância entre a idade fisiológica e a idade cronológica, sendo maiores as margens de erro (Cunha *et al.*, 2009; De Luca *et al.*, 2010).

Em qualquer faixa etária, porém, é necessário que haja uma padronização do procedimento, com observação cautelosa de recomendações e diretrizes atuais para a estimativa da idade das pessoas vivas, para que os resultados sejam confiáveis e eficazes (Schmeling *et al.*, 2008).

Sabe-se que a realidade brasileira é pouco abordada em publicações da área e envolve limitações relacionadas a recursos técnicos e equipamentos para realização de exames complementares (Solon, 2008; Berutti *et al.*, 2017). Assim, o estudo dos métodos usados na realidade pericial é de grande importância, o qual pode, associado ao estudo da casuística e do

perfil do periciado desse tipo de exame, contribuir com o avanço do conhecimento forense sobre o tema.

Diante disso, o objetivo desse trabalho foi realizar um estudo retrospectivo, analisando os laudos de exames de estimativa de idade realizados em indivíduos vivos no Instituto Médico-Legal de Porto Velho, Rondônia, Brasil, buscando avaliar a quantidade e as características dessas perícias, incluindo a análise dos métodos utilizados durante o exame e os fundamentos usados pelos peritos para concluir os laudos.

## **2 ARTIGO: Forensic age estimation in living individuals: characteristics and casuistry**

Artigo submetido ao periódico “The Journal of Forensic Odonto-Stomatology – JFOS” (Anexo 1)

### **ABSTRACT**

**Introduction:** The age estimation in living aims to assess the process of physical, skeletal, and dental development and maturation, through specific methods and techniques to clarify civil, criminal and administrative cases.

**Objectives:** The aim of this study was to carry out a retrospective study, analyzing the reports of age estimation tests performed on living individuals at the Institute of Legal Medicine of Porto Velho, Rondônia, Brazil, seeking to assess the quantity and characteristics of these forensics, including the analysis of methods used during the examination and the fundamentals used by the experts to conclude the reports.

**Methods:** For the retrospective analysis, a cross-sectional study was carried out, based on records and reports of forensic examinations of age estimation performed on living individuals, examined at the Institute of Legal Medicine of Porto Velho, Rondônia, Brazil in the period between January 2013 and December of 2019.

**Results:** Among the 271 selected reports, it was possible to observe that the expertise was related to criminal proceedings in only six cases (2.21%), most of which were requested to substantiate civil proceedings (97.79%).

**Conclusion:** A high number of age estimation tests was evidenced in living individuals in the Amazon region of Brazil, especially linked to civil cases and in adults and elderly. It was possible to highlight the importance of a thorough clinical examination of the whole body, with observation of macroscopic characters related to growth and aging, associated with the clinical examination of the teeth, with due and careful analysis of the case history, especially when there is a lack of radiographic examinations prevent the application of more accurate methods. The radiological examination must be carried out whenever available, as it is the method that gives more precision to the analyses.

**Keywords:** Forensic anthropology; forensic dentistry; age determination by skeleton; age determination by teeth; age estimation in living.

## INTRODUCTION

Forensic experts perform various types of analysis related to their field of expertise, including forensic identification of cadavers, the analysis of traumatic injuries present in the maxillofacial complex and age estimation tests in living individuals (Solon, 2008).

The age estimation in living aims to assess the process of physical, skeletal, and dental development and maturation, through specific methods and techniques to clarify civil, criminal and administrative cases (Black, Aggrawal and Payne-James, 2010). It is one of the most complex exams during forensic expertise, as the impossibility of using invasive methods that consume human tissue or that require tooth extraction reduces the range of studies that can be used in the analysis and makes the process more delicate (Jeevan *et al.*, 2011).

Furthermore, development, growth and aging are influenced by several factors, such as genetic factors, differences between population groups, nutrition, hormonal action, diseases, lifestyle, socioeconomic status, and environmental factors (Black, Aggrawal and Payne-James, 2010; De Luca *et al.*, 2010). In children and sub-adults, there is a lower degree of error regarding age estimation, due to the low individual variability of morphological characteristics of bone and dental development, which occur within previously known patterns (De Luca *et al.*, 2010). However, the end of human tissue growth and development that occurs around 20 to 25 years of age reduces the characters available for age assessment and reduces the accuracy of the methods that can be used in adults and the elderly, as aging is far more variable and less predictable than human development. The older the person, the greater the discrepancy between physiological age and chronological age, with greater margins of error (Cunha *et al.*, 2009; De Luca *et al.*, 2010).

In any age group, however, it is necessary to standardize the procedure, with careful observation of current recommendations and guidelines for estimating the age of living people, so that the results are reliable and effective (Schmeling *et al.*, 2008).

It is known that the Brazilian reality is little addressed in publications in the area and involves limitations related to technical resources and equipment for performing complementary exams (Solon, 2008; Berutti *et al.*, 2017). Thus, the study of the methods used in the forensic reality is of great importance, which, associated with the study of the sample and the profile of the expert in this type of examination, can contribute to the advancement of forensic knowledge on the field.

The aim of this study was to carry out a retrospective study, analyzing the reports of age estimation tests performed on living individuals at the Institute of Legal Medicine of Porto Velho, Rondônia, Brazil, seeking to assess the quantity and characteristics of these forensics,

including the analysis of methods used during the examination and the fundamentals used by the experts to conclude the reports.

## **MATERIAL AND METHODS**

The study was approved by the Research Ethics Committee of FOP -UNICAMP (Protocol number: CAAE 26695119.3.0000.5418).

For the retrospective analysis, a cross-sectional study was carried out, based on records and reports of forensic examinations of age estimation performed on living individuals, examined at the Institute of Legal Medicine of Porto Velho, Rondônia, Brazil in the period between January 2013 and December of 2019.

For inclusion criteria, only age estimation reports related to expertise in living individuals of any sex and skin color were included. Inconclusive reports, with insufficient information and/or that did not meet the inclusion criteria were excluded.

All reports were analyzed by a single researcher who was previously calibrated as to the information to be obtained and observed.

The information collected was entered into an electronic spreadsheet (Microsoft Excel®) and submitted to descriptive statistical analysis, with the presentation of results in percentage (%) in tables and graphs.

## **RESULTS**

There were 273 reports involving living individuals submitted to examination within the seven years selected for the study. Considering the inclusion criteria, two of these reports were excluded from the study for being inconclusive. Among the 271 selected reports, it was possible to observe that the expertise was related to criminal proceedings in only six cases (2.21%), most of which were requested to substantiate civil proceedings (97.79%).

Among the criminal cases, two referred to police encounters of unknown living people, admitted to the psychiatric section of a local public hospital, who had no documents and could not say who they were. Two cases concerned individuals arrested without official documents, one of which claimed to be under 18 years of age. Finally, the fifth and sixth criminal cases referred, respectively, to an individual from Somalia, arrested by the Federal Police with documents that aroused suspicion and stating that he was 17 years old, and to another individual arrested with new documents, recently issued, which also raised questions about the age and identity of the individual.

Including cases related to civil legal field the main reasons for the requests were related to people who had never had documents in their lives (31.00%) and who, in different age groups, sought the civil justice system to issue these documents. Cases were also very frequent (25.09%) of individuals who already had documents, but these were lost, damaged or stolen, and when the duplicate was requested, these individuals were unable to issue it because they were not registered in any local registry office. Then, there were cases of individuals who alleged errors in their documents related to the registered birth date (24.35%) or about other registration data such as name and document number (6.27%), forwarded by the judge to examination to confirm your age. Finally, there was a case in which the person was alive (0.37%), but somehow, he was officially declared dead and had to file a lawsuit to prove that he was alive. In 10.70% of the reports, the reason for requesting the exam was not described.

Overall, the number of age estimation tests ranged from 21 to 55 cases per year, without demonstrating a specific trend over the study period (Fig. 1).

The most of individuals were male (58.67%), with an estimated age ranging from 2.5 to 90 years (Table 1). Adults between 50 and 69 years (44.28%) were the most frequent among the experts.

Figure 1. Number of age estimate exams per year.

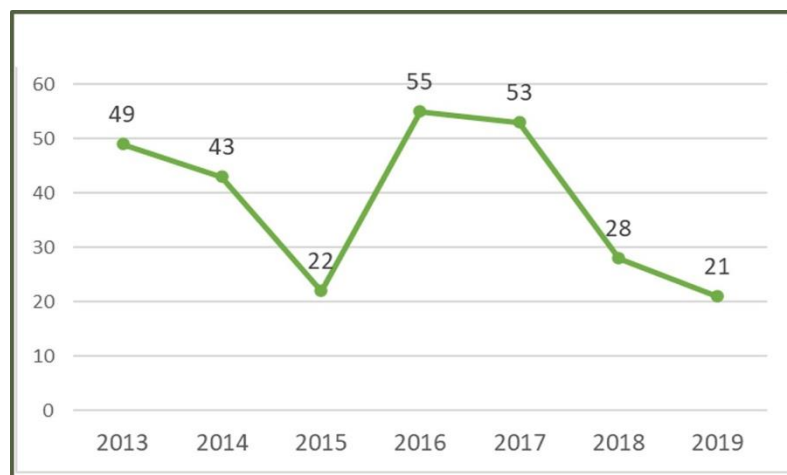


Table 1 - Age and sex distribution of individuals.

| Age             | Female       | Male          | Total         |
|-----------------|--------------|---------------|---------------|
| 1. Child (1-11) | 7<br>(2.58%) | 13<br>(4.80%) | 20<br>(7.38%) |

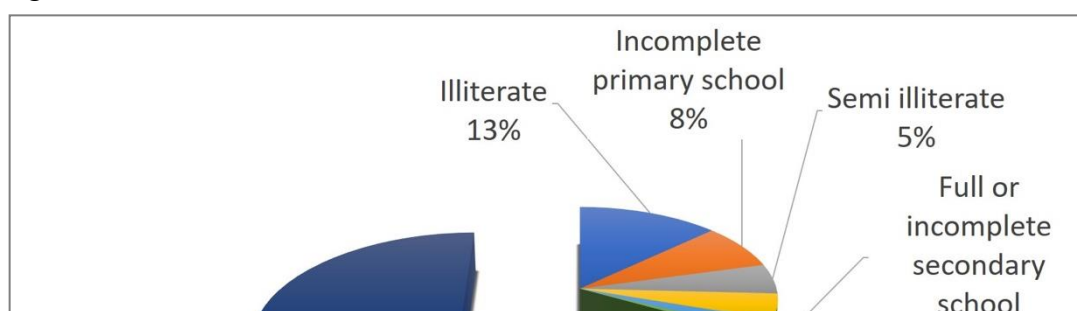
|                                |     |          |     |          |     |           |
|--------------------------------|-----|----------|-----|----------|-----|-----------|
| 2. Adolescent (12-18)          | 5   | (1.85%)  | 7   | (2.58%)  | 12  | (4.43%)   |
| 3. Young (19-21)               | 3   | (1.11%)  | 6   | (2.21%)  | 9   | (3.32%)   |
| 4.1 Adult young (22-29)        | 5   | (1.85%)  | 7   | (2.58%)  | 12  | (4.43%)   |
| 4.2 Middle age adult (30 - 39) | 13  | (4.80%)  | 11  | (4.06%)  | 24  | (8.86%)   |
| 4.3 Middle age adult (40 - 49) | 21  | (7.75%)  | 27  | (9.96%)  | 48  | (17.71%)  |
| 4.4 Middle age adult (50 - 59) | 27  | (9.96%)  | 34  | (12.55%) | 61  | (22.51%)  |
| 5.1 Elderly (60 - 69)          | 23  | (8.49%)  | 36  | (13.28%) | 59  | (21.77%)  |
| 5.2 Elderly (>70a)             | 8   | (2.95%)  | 18  | (6.64%)  | 26  | (9.59%)   |
| Total                          | 112 | (41.33%) | 159 | (58.67%) | 271 | (100.00%) |

Only 90 (33.21%) reports mentioned the education level of the individuals (Fig. 2), most of whom were illiterate (12.92%), had incomplete elementary school (7.75%) or were semi-literate (5.17 %). Birthplace of the individuals in the northern region of Brazil were more common (73.80%), although there were individuals were from all regions of the country, in addition to one born in Somalia and another from Bolivia (Table 2).

Table 2 – Birthplace of the individuals.

| Local de Origem        | Quantidade |           |
|------------------------|------------|-----------|
| North of Brazil        | 200        | (73.80%)  |
| Northeast of Brazil    | 26         | (9.60%)   |
| Southeastern of Brazil | 13         | (4.80%)   |
| Midwest of Brazil      | 5          | (1.80%)   |
| South of Brazil        | 5          | (1.80%)   |
| Somalia                | 1          | (0.37%)   |
| Bolivia                | 1          | (0.37%)   |
| Uninformed             | 20         | (7.38%)   |
| Total                  | 271        | (100.00%) |

Figure 2. Educational level.





Regarding the methods and fundamentals used during the investigation, it was observed that all cases had the history as part of the report. During the interview to formulate the case history, the expert investigated in 22.14% of the reports on the use of medication and/or on the presence of diseases and health conditions. In 16.61% of the cases, exposure to the sun was investigated and in 11.07% of the cases the use of drink and cigarettes was investigated by the professional during the interview.

During the physical evaluation, the forensic expert analyzed some clinical signs related to age (Table 3), such as the analysis of the examinee's weight and height, present in 95.94% of the reports. The characteristics of the skin (95.20%), the hair (100%), the eyebrows (84.13%), the eyes (97.04%), the nose (85.97%) and the ears (46.49%). The subject's balance (24.35%) and walking (53.87%) were also assessed during the examination in some cases.

During the clinical dental examination of the examinee (Table 4), information about caries lesion, lost and/or restored teeth was observed in 123 cases (34.68%). Tooth wear was examined in 94 cases (34.68%), tooth color was mentioned in only 16 reports (5.90%) and periodontal changes were observed in 29 reports (10.70%).

Among the 41 reports from subadult individuals, 38 reports described which deciduous and permanent teeth were erupted, in addition to 9 reports from forensic specialists in early adulthood who also presented this information. However, among these 47 reports, only six specified which method related to tooth eruption had been used to estimate age. Among the methods mentioned were the Atlas by AlQahtani *et al.* (2010) and two Brazilian tables known as the Arbenz Dental Eruption Table (1964) and Ernestino Lopes da Silva Júnior's Table (1931), cited by França (2011). Such methods were each used in three reports. The Ubelaker Diagram (1999) was also cited in two cases.

In 136 (50.19%) reports it was possible to observe reference to the radiographic analysis, but only 78 (25.46%) of them indicated the type of radiography used (Table 5). The radiography of the hand and wrist region was the most frequent (n=67; 24.72%). Cranial radiographs in anteroposterior view were presented in 64 cases (23.62%) and in lateral view in 47 cases (17.34%). Panoramic radiographic examination was used only in 12 cases (4.43%).

Table 3 - Number of reports in which each physical characteristic was examined, according to the age.

| Physical characteristic    | Age                |                          |                     |                     |                     |            |               |  |
|----------------------------|--------------------|--------------------------|---------------------|---------------------|---------------------|------------|---------------|--|
|                            | 1. Child<br>(1-11) | 2. Adolescent<br>(12-18) | 3. Young<br>(19-21) | 2. Adult<br>(22-59) | 5. Elderly<br>(>60) | Total      |               |  |
| Weight and/or height       | 18 (90%)           | 12 (100.00%)             | 9 (100.00%)         | 138 (95.17%)        | 83 (97.65%)         | 260        | (95.94%)      |  |
| Skin                       | 14 (70%)           | 11 (91.67%)              | 8 (88.89%)          | 140 (96.55%)        | 85 (100.00%)        | 258        | (95.20%)      |  |
| Wrinkles                   | (0%)               | 1 (8.33%)                | 4 (44.44%)          | 127 (87.59%)        | 85 (100.00%)        | 217        | (80.07%)      |  |
| Stains                     | 0 (0%)             | 1 (8.33%)                | 0 (0.00%)           | 10 (6.90%)          | 3 (3.53%)           | 14         | (5.17%)       |  |
| Hair                       | 20 (100%)          | 12 (100.00%)             | 9 (100.00%)         | 142 (97.93%)        | 88 (103.53%)        | 271        | (100.00%)     |  |
| Type                       | 20 (100%)          | 11 (91.67%)              | 9 (100.00%)         | 122 (84.14%)        | 65 (76.47%)         | 227        | (83.76%)      |  |
| Length                     | 17 (85%)           | 10 (83.33%)              | 8 (88.89%)          | 114 (78.62%)        | 66 (77.65%)         | 215        | (79.34%)      |  |
| Colour                     | 20 (100%)          | 12 (100.00%)             | 9 (100.00%)         | 116 (80.00%)        | 38 (44.71%)         | 195        | (71.96%)      |  |
| Canice                     | 0 (0%)             | 1 (8.33%)                | 0 (0.00%)           | 88 (60.69%)         | 77 (90.59%)         | 166        | (61.25%)      |  |
| Baldness and hair thinning | 0 (0%)             | 0 (0.00%)                | 0 (0.00%)           | 28 (19.31%)         | 23 (27.06%)         | 51         | (18.82%)      |  |
| Eyebrows                   | 5 (25%)            | 7 (58.33%)               | 9 (100.00%)         | 127 (87.59%)        | 80 (94.12%)         | 228        | (84.13%)      |  |
| Beard and mustache         | 3 (15%)            | 1 (8.33%)                | 3 (33.33%)          | 16 (11.03%)         | 11 (12.94%)         | 34         | (12.55%)      |  |
| Axillary and/or pubic hair | 2 (10%)            | 3 (25.00%)               | 0 (0.00%)           | 3 (2.07%)           | 0 (0.00%)           | 8          | (2.95%)       |  |
| Body hair                  | 2 (10%)            | 1 (8.33%)                | 0 (0.00%)           | 14 (9.66%)          | 4 (4.71%)           | 21         | (7.75%)       |  |
| Eyes                       | 17 (85%)           | 12 (100.00%)             | 9 (100.00%)         | 138 (95.17%)        | 87 (102.35%)        | 263        | (97.05%)      |  |
| Colour                     | 17 (85%)           | 11 (91.67%)              | 9 (100.00%)         | 140 (96.55%)        | 82 (96.47%)         | 259        | (95.57%)      |  |
| Degenerative changes       | 0 (0%)             | 0 (0.00%)                | 0 (0.00%)           | 63 (43.45%)         | 55 (64.71%)         | 118        | (43.54%)      |  |
| Nose                       | 6 (30%)            | 8 (66.67%)               | 9 (100.00%)         | 131 (90.34%)        | 79 (92.94%)         | 233        | (85.98%)      |  |
| Ear                        | 6 (30%)            | 2 (16.67%)               | 1 (11.11%)          | 73 (50.34%)         | 44 (51.76%)         | 126        | (46.49%)      |  |
| Walking                    | 9 (45%)            | 5 (41.67%)               | 4 (44.44%)          | 82 (56.55%)         | 46 (54.12%)         | 146        | (53.87%)      |  |
| Balance                    | 5 (25%)            | 1 (8.33%)                | 0 (0.00%)           | 44 (30.34%)         | 16 (18.82%)         | 66         | (24.35%)      |  |
| <b>Total</b>               | <b>20 (100%)</b>   | <b>12 (100%)</b>         | <b>9 (100%)</b>     | <b>145 (100%)</b>   | <b>85 (100%)</b>    | <b>271</b> | <b>(100%)</b> |  |

Table 4 - Number of reports in which each dental characteristics investigated according to the age.

| Dental characteristics               | Age                 |                          |                     |                      |                     | Total             |
|--------------------------------------|---------------------|--------------------------|---------------------|----------------------|---------------------|-------------------|
|                                      | 1. Child<br>(1-11)  | 2. Adolescent<br>(12-18) | 3. Young<br>(19-21) | 4. Adult<br>(22-59)  | 5. Elderly<br>(>60) |                   |
| Teeth colours                        | 0 (0.00%)           | 0 (0.00%)                | 0 (0.00%)           | 13 (8.97%)           | 3 (3.53%)           | 16 (5.90%)        |
| Teeth wear                           | 3 (15.00%)          | 0 (0.00%)                | 1 (11.11%)          | 67 (46.21%)          | 23 (27.06%)         | 94 (34.68%)       |
| Periodontal changes                  | 0 (0.00%)           | 2 (16.67%)               | 0 (0.00%)           | 20 (13.79%)          | 7 (8.24%)           | 29 (10.70%)       |
| Teeth with caries, missing or filled | 10 (50.00%)         | 4 (33.33%)               | 1 (11.11%)          | 77 (53.10%)          | 31 (36.47%)         | 123 (45.38%)      |
| Erupted teeth                        | 20 (100.00%)        | 11 (91.67%)              | 7 (77.78%)          | 9 (6.21%)            | 0 (0.00%)           | 47 (17.34%)       |
| <b>Total</b>                         | <b>20 (100.00%)</b> | <b>12 (100.00%)</b>      | <b>9 (100.00%)</b>  | <b>145 (100.00%)</b> | <b>85 (100.00%)</b> | <b>271 (100%)</b> |

Table 5 - Number of reports in which each radiograph investigated according to the age.

| Radiograph            | Age                 |                          |                     |                      |                     | Total                |
|-----------------------|---------------------|--------------------------|---------------------|----------------------|---------------------|----------------------|
|                       | 1. Child<br>(1-11)  | 2. Adolescent<br>(12-18) | 3. Young<br>(19-21) | 4. Adult<br>(22-59)  | 5. Elderly<br>(>60) |                      |
| <b>Radiographies</b>  | 20 (100.00%)        | 12 (100.00%)             | 8 (88.89%)          | 68 (46.90%)          | 28 (32.94%)         | 136 (50.18%)         |
| Panoramic             | 4 (20.00%)          | 2 (16.67%)               | 1 (11.11%)          | 2 (1.38%)            | 3 (3.53%)           | 12 (4.43%)           |
| Hand and wrist region | 11 (55.00%)         | 5 (41.67%)               | 3 (33.33%)          | 35 (24.14%)          | 13 (15.29%)         | 67 (24.72%)          |
| Anteroposterior Skull | 8 (40.00%)          | 3 (25.00%)               | 1 (11.11%)          | 38 (26.21%)          | 14 (16.47%)         | 64 (23.62%)          |
| Lateral Skull         | 8 (40.00%)          | 2 (16.67%)               | 0 (0.00%)           | 31 (21.38%)          | 6 (7.06%)           | 47 (17.34%)          |
| Uninformed            | 5 (25.00%)          | 5 (41.67%)               | 5 (55.56%)          | 30 (20.69%)          | 13 (15.29%)         | 58 (21.40%)          |
| <b>Total</b>          | <b>20 (100.00%)</b> | <b>12 (100.00%)</b>      | <b>9 (100.00%)</b>  | <b>145 (100.00%)</b> | <b>85 (100.00%)</b> | <b>271 (100.00%)</b> |

In relation to the radiographic analysis methods for age estimation, it was observed that the Atlas of Greulich-Pyle (1959) was used in 56 reports, the Method of Nicodemo, Moraes and Médici (1974) was cited in 7 reports. Other methods were mentioned in 5 reports, such as Diagram by Ubelaker (1999), Atlas by AlQahtani *et al.* (2010), Nolla's Method (Nolla, 1960), Smith's Method (Smith, 1991), Anderson's Method (1976), Demirjian's Method (1973), Willems' Method *et al.* (2001), Gunst *et al.* (2003) and Solari & Abramovich (2002). The measurement of the mandibular angle was mentioned in 230 (84.87%) reports.

Only 16 (5.90%) reports contained photos, of which 15 (5.54%) were located at the end of the report as an attachment and only one presented the image in the body of the report, in the description section. The content of the images was the face of the individual (11; 4.06%), the intraoral situation of the examinee (10; 3.69%) or the radiographic images used in the expert analysis (5; 1.85%).

All reports presented the discussion section, and, in most cases, the experts based their conclusions on the physical and dental examination and on the life history narrated by the expert (130; 47.97%) or on these aspects added to the radiographic examination (121; 44.65%).

In 98.5% (267) of the reports, the final age estimate was described in the conclusion as a point, which represents the most likely age for the individual of unknown age, and an associated dispersion interval. Only 4 (1.5%) reports presented the conclusion as an age range.

Most of the reports were signed only by dentists (265; 97.8%), and 6 (2.2%) reports were jointly responsible for medical experts and dentists.

## DISCUSSION

The retrospective study evidenced a high amount of age estimation tests in living individuals carried out at the Institute of Legal Medicine of Porto Velho, Rondônia, Brazil, but it was not possible to demonstrate a trend of growth in this type of test at the site. Other studies (Schmeling *et al.*, 2001, 2003; Maggio, 2017; Sykes, Bhayat and Bernitz, 2017) have shown an increase in these statistics in European countries, which may be related to the migration crisis recently faced by many of these countries, with presence of illegal immigrants without valid documents, who are only entitled to asylum if they are minors, as well as juvenile offenders being tried in court (Sykes, Bhayat and Bernitz, 2017).

Despite being an expert institute linked to a criminal investigation body, it was observed in this research that the Institute of Legal Medicine of Porto Velho, Rondônia, Brazil,

received more requests for non-criminal examinations, highlighting the great need that the local legal system has in civil scope.

Among the criminal cases, there were specific histories that point to the absence of documents or suspicious data in the registration documents presented. Accurate estimation of age in this group is crucial as it can have serious and important legal implications. In Brazil, minors under 18 years of age, when suspected of committing crimes, respond under special criminal legislation, being considered unimputable under Brazilian law (Brazil, 1940, 1990) and therefore knowing their age is decisive for the proper legal process of these individuals. The age of 14 is also important in cases of sexual violence, as at this age the victim is considered vulnerable.

Among civil cases, people who never had a document were common, evidencing the lack of access to basic rights faced by the population of the region. The weakness of the civil infrastructure can be blamed for the high rate of documents with incorrect birth dates due to administrative error (24.35%) and the high frequency of cases of impossibility of issuing a duplicate of the document (25.09%) for lack of registration in the notary offices (Phillips and Narayanasamy, 2010).

There are many elements that contribute to under-registration, including factors ranging from limited state budget resources to lack of information by families about the procedures necessary for registration; from the numerous difficulties in reaching a registry office or registration post (whether due to distance or lack of resources for transport) to discriminations and entrenched prejudices, structurally maintained (Brasil, 2018). Illiterate people or people with lower levels of education were more common among the experts in this study, which confirms the above.

The characteristics of the Brazilian Amazon, located in the northern region of the country, from where most of the experts in the study came from, are highlighted. In addition to showing peculiarities in the social, cultural and economic spheres, the region presents huge obstacles related to mobility and lack of infrastructure, especially in regions farther away from urban centers and among riverside populations, which also influences the issue.

As for the profile of the individuals, previous studies in other expert institutes (Schmeling *et al.*, 2001; Santoro *et al.*, 2009; Berutti *et al.*, 2017) showed that the estimated age comprised younger groups, especially related the indication of criminal liability. In the

present study, the individuals were mostly adults and elderly, which makes the examination extremely difficult due to the lack of methods available for these age groups.

Regarding the aspects of the individual recorded during the examination by the expert, in the first stage of the expert examination, the expert investigated the life history of the individual through an interview, making his observations appear in the history present in all the reports surveyed. Although the morphological evidence is more reliable, the careful use of the life history can allow reaching a supposed age referred by the expert. Many individuals without official documents may present other types of formal documents such as a baptism record, a vaccination booklet, and a newborn medical test record, which contain a record of the date of birth. Such unofficial records can be considered during the forensic examination, as well as the supposed age referred by the examinee himself can be considered in civil cases, if they are biologically compatible with the findings of the physical and radiographic examinations (Phillips and Narayanasamy, 2010).

At this stage, it is possible to inquire about conditions known to alter the individual's growth or accelerate the aging process (Schmeling *et al.*, 2008; Black, Aggrawal and Payne-James, 2010), which were considered in part of the reports of the present research, such as the presence of diseases, the individual's health conditions and the use of medications, exposure to the sun and the use of drink and cigarettes.

The physical signs observed in the clinical examination may be linked to growth and aging and were frequently evaluated among the cases in the present study, including the analysis of anthropometric characters of weight and height and of skin, hair and body hair characteristics. The living age estimation protocol proposed by the Study Group on Forensic Age Diagnostics (SGFAD) advocates physical examination, which should include anthropometric analyses, examination of sexual characteristics and investigation of developmental disorders (Schmeling *et al.*, 2008). These markers can be very useful when subjects are under 14 years old, especially at the time of growth spurts, and provide valuable corroboration for more reliable methods. However, they require access to the most intimate and private anatomy of the person being evaluated and are not particularly accurate indicators. They cannot replace more objective skeletal and dental markers and should be used with care as supplementary information due to their variability, as some diseases can generate disproportionate growth (Santoro *et al.*, 2009; Black, Aggrawal and Payne-James, 2010).

In older individuals, facial hair, and soft tissue, assessed by physical examination, contribute substantially to age estimation. The appearance of wrinkles and skin spots, hair thinning, baldness and the appearance of gray hair are phenomena related to aging and should be registered during the examination (Black, Aggrawal and Payne-James, 2010; Ichibori *et al.*, 2014; Ramos and Miot, 2015; Ko, Korn and Kikkawa, 2017; Tsuboi *et al.*, 2019; York *et al.*, 2020). Some signs of senescence can also be seen in the eyes such as senile arch, dermatochalasis, pterygium and pinguecula (Atchison *et al.*, 2008; Deliaert *et al.*, 2012; Grossniklaus *et al.*, 2012; Jacobs *et al.*, 2014; Song *et al.*, 2017; Rezvan *et al.*, 2018; Wanzeler *et al.*, 2019). Such phenomena are complex and require care as they also reflect genetic, environmental, and pathological influences. In summary, individual morphological markers have a low positive predictive value for age but, in combination, suggest that the person is of advanced age (Black, Aggrawal and Payne-James, 2010; Phillips and Narayanasamy, 2010).

The evaluation of teeth is essential for estimating the age of the individual and provides valuable information for the expert, having been very frequent among the cases of children, adolescents and sub-adults evaluated in the study. Direct dental examination through clinical examination is important to verify the number of erupted teeth, the sequence of eruption and the condition of the teeth (Berutti *et al.*, 2017), including recording periodontal changes and missing, decayed and restored teeth, which indicate that the tooth has been present for a considerable time in the mouth, enough to suffer the action of destructive and pathological phenomena.

Among adults and the elderly, dental conditions and wear were evaluated in more than 34% of the reports, which may represent temporal signs present in the dental arches. Some methods (Miles, 1958; Smith, 1984; Lovejoy, 1985) sought to analyze tooth wear, but it still constitutes a very variable parameter, which depends on several factors such as number of teeth, angle, size and position, bruxism, diet, and presence of dental restorations, as well as occupational, habitual, and even factors linked to geographically and culturally diverse populations (Black, Aggrawal and Payne-James, 2010).

Of all the various methods and procedures available for estimating age, radiographs represent the most objective method for observing tooth and bone maturity (Santoro *et al.*, 2009; Mohammed *et al.*, 2014). Radiographs of the hand and wrist region and comparison with atlases and reference studies (Greulich and Pyle, 1959; Tanner and Whitehouse, 1984; Schmeling *et al.*, 2008) for estimating age are of great value in sub-adult skills when making the less



subjective examination for a more accurate conclusion (Santoro *et al.*, 2009). However, among the 41 reports of children, adolescents and young people evaluated in the study, only 19 (46.34%) had radiographs of the carpal region, showing that more than half of the sub-adult surveys did not use this tool.

In children, adolescents and sub-adults, several methods can currently be pointed out as references for the correlation of the dental development stage with the individual's estimated age (Nolla, 1960; Nicodemo, Moraes and Medici-Filho, 1974; Anderson, Thompson and Popovich, 1976 ; Smith, 1991; Willems *et al.*, 2001; Cameriere, Ferrante and Cingolani, 2006; Cameriere *et al.*, 2007, 2008). In Brazil, the best known is the method by Nicodemo, Moraes and Medici-Filho (1974), elaborated with a sample of Brazilian children and adolescents and considering eight stages of mineralization for each individual's tooth, providing at the end an estimated age range in months of life. This method was mentioned in only 7 reports (2.58%), but it is argued that it may have been used in other cases in the present study whose reports did not show any record of the method used.

Among adults and the elderly, radiological observation of the reduction of the pulp chamber of teeth present by apposition of secondary dentin is a useful method, it does not depend on sex and shows satisfactory results (De Luca *et al.*, 2010). It is more reliable than most other methods of estimating age in adults (Cameriere *et al.*, 2004) and is used by current studies (Kvaal *et al.*, 1995; Cameriere *et al.*, 2004; Jeevan *et al.*, 2011; Marroquin *et al.*, 2017) to estimate age in individuals in which tooth development and bone maturation have already been completed. The reports of the present study, however, did not record the type of method that was used to assess the proportions between the pulp and the tooth.

In individuals with a mean age above 45–50 years, there are few methods available in the current literature. In this age group, due to the great variability of human senescence, morphological methods of age estimation do not provide sufficiently accurate results. The level of reliability and accuracy may vary from study to study, but no reliable method appears to exist yet (Meindl and Russell, 1998; Buckberry and Chamberlain, 2002; Cattaneo *et al.*, 2008; Black, Aggrawal and Payne-James, 2010 ; De Luca *et al.*, 2010).

In general, the expert reality has limitations in the use of complementary exams. Imaging exams require submitting the individual to radiographic exposure and not all expert institutes have available resources and radiological equipment for use in living individuals,

which prevents the application of some methodologies in the forensic routine (Phillips and Narayanasamy, 2010; Assis, 2011; Berutti *et al.*, 2017).

In these cases, the clinical examination assumes a remarkable importance since it is a method that does not cause damage to bodily tissues, does not require any type of equipment or reagent, is less costly and has more immediate interpretation, and is therefore more applicable practice. The results obtained with its application provide a high relationship with the growth and aging process and, if certain precautions are considered, they can produce estimation errors within acceptable limits, especially if several clinical signs are evaluated together (Guedes, 2013). However, great caution must be applied in this context as such macroscopic signs are extremely variable between individuals, their assessment is subjective and should not be considered in isolation, especially in criminal investigations where age is the limit for the application of legislation special to the victim or the accused, as the cases of definition of age, which demand greater precision and accuracy than cases of civil expertise.

When deciding on an age estimation technique, one must consider the purpose of the examination and how accurate and reliable the diagnosis must be, according to the request made by the requester. In addition, the context, costs, time available, the qualifications of the examiner, as well as whether the necessary equipment is available to the examiner matters greatly (De Luca *et al.*, 2010; Mohammed *et al.*, 2014; Sykes, Bhayat and Bernitz, 2017). Thus, international protocols based on the European reality may not be easily applied in the Brazilian reality due to the lack of available equipment and lack of access to specific complementary exams.

In the discussion section, where the expert should point out the method he used to reach his conclusion, basing his decision on the literature (Thevissen, Fieuws and Willems, 2010; Berutti *et al.*, 2017; Sykes, Bhayat and Bernitz, 2017), there was weakness in the reports. Although all reports have a discussion section, it was observed that most of them did not include the reference methods used for both the analysis of age-related clinical dental signs and for radiographic evaluation.

Regarding the conclusion of the report, Black, Aggrawal and Payne-James (2010) advise that the estimated result be presented in the form of a point, which represents the most likely age for the individual of unknown age, and an associated "confidence interval" (margins of error), which is the quantification of the uncertainty associated with the estimate, as was done in most of the reports (98.5%) evaluated in this study. Another way to present the

estimated age would be to establish a time interval limiting a minimum and a maximum age as a conclusion, as done in only four reports of this study.

Some situations will require different approaches when the case asks whether the individual is younger or older than a chronological age arbitrarily defined by law. These questions can be better answered and presented in court as a percentage, based on the likelihood ratio calculated for the case using specific methods (Black, Aggrawal and Payne-James, 2010). That is, the percentage of chance of having the individual more or less than a specific age will be indicated. This way of presenting the results was not observed in the present study.

The professional responsible for the examinations was the dentist in 97.8% of the reports, which is based on international doctrine and Brazilian legislation. Its competence is regulated by article 6 of Law 5081 (Brasil, 1966) and its participation in this type of expertise involves specific knowledge of Dentistry. As teeth are the body structures that provide the best information for age estimation (Silva *et al.*, 2008), it is understood that the participation of the dentist in carrying out the examinations in question is essential (Berutti *et al.*, 2017). Santoro *et al.* (2009) argue that few physicians are qualified in forensic age determination and recommend entrusting specialist pathologists and dentists with the task of assessing age.

Finally, the search for techniques for estimating living age is far from complete, as the tests remain unsatisfactory and require caution in their application. The structure of the expert bodies and institutes need to receive massive investments for the application of more accurate complementary exams. As Maples (1989) states: "Age estimation is ultimately an art, not a precise science."

## CONCLUSION

In conclusion, a high number of age estimation tests was evidenced in living individuals in the Amazon region of Brazil, especially linked to civil cases and in adults and elderly. It was possible to highlight the importance of a thorough clinical examination of the whole body, with observation of macroscopic characters related to growth and aging, associated with the clinical examination of the teeth, with due and careful analysis of the case history, especially when there is a lack of radiographic examinations prevent the application of more accurate methods. The radiological examination must be carried out whenever available, as it is the method that gives more precision to the analyses.

The results of this study contribute to the discussion on the need for constant scientific updating by experts and the urgent need to publish an age estimation protocol for living individuals specific to the Brazilian reality, especially adults and elderly when working in adult and elderly individuals in which body growth and development have already been completed.

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### **3 CONCLUSÃO**

O presente trabalho evidenciou um alto número de exame de estimativa de idade em indivíduos vivos na região amazônica do Brasil, especialmente ligados a casos cíveis e em adultos e idosos. Foi possível destacar a importância de um exame clínico criterioso de todo o corpo, com observação de caracteres macroscópicos relacionados ao crescimento e ao envelhecimento, associado ao exame clínico dos dentes, com a devida e cuidadosa análise do histórico do caso, especialmente quando a falta de exames radiográficos impede a aplicação de métodos mais precisos. O exame radiológico deve ser feito sempre que disponível, pois é o método que confere mais precisão às análises.

Os resultados do presente trabalho contribuem para a discussão sobre a necessidade de constante atualização por parte dos peritos e para a urgente necessidade de publicação de um protocolo de estimativa de idade para indivíduos vivos específico para a realidade brasileira, especialmente adultos e idosos quando se atua em indivíduos adultos e idosos em que o crescimento e o desenvolvimento corporal já estão finalizados.

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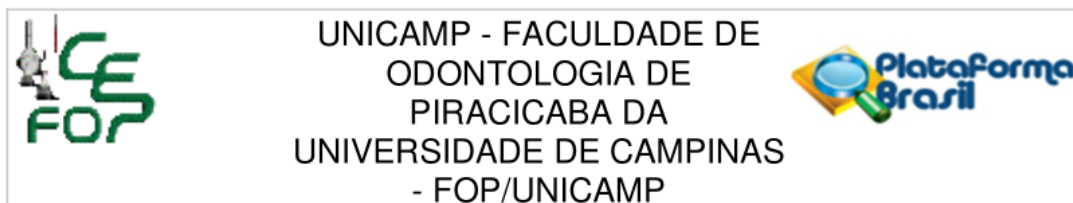
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## ANEXO 2 - Certificado de Aprovação no Comitê de Ética em Pesquisa



### PARECER CONSUBSTANCIADO DO CEP

#### DADOS DO PROJETO DE PESQUISA

**Título da Pesquisa:** Estimativa de idade em indivíduos vivos: características e casuística

**Pesquisador:** Talita Lima de Castro Espicalsky

**Área Temática:**

**Versão:** 2

**CAAE:** 26695119.3.0000.5418

**Instituição Proponente:** Faculdade de Odontologia de Piracicaba - Unicamp

**Patrocinador Principal:** Financiamento Próprio

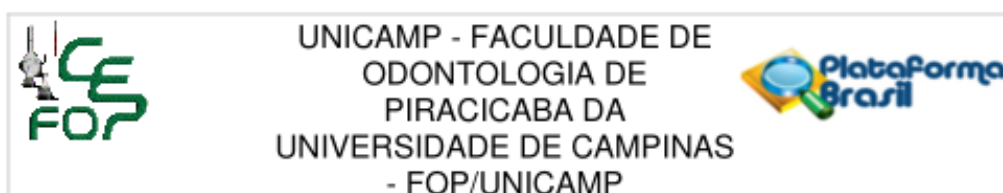
#### DADOS DO PARECER

**Número do Parecer:** 3.772.553

#### Apresentação do Projeto:

Transcrição editada do conteúdo do registro do protocolo e dos arquivos anexados à Plataforma Brasil Pendência 1 (atendida em 13/12/2019)- A LISTA DE PESQUISADORES citada na capa do projeto de pesquisa inclui TALITA LIMA DE CASTRO ESPICALSKY (Cirurgiã-Dentista, Perita Odontóloga Legal do Instituto Médico Legal de Porto Velho/RO, Colaboradora junto à área de Anatomia da FOP-UNICAMP, Pesquisadora responsável), LÍDIA ALMEIDA LIMA DE CASTRO (Cirurgiã-Dentista, Mestranda no PPG em Biologia Buco-Dental, área de Odontologia Legal e Deontologia, da FOP-UNICAMP, Pesquisadora participante), ANA CLÁUDIA ROSSI (Cirurgiã-Dentista, Docente da área de Anatomia da FOP-UNICAMP, Pesquisadora participante, Orientadora), o que é confirmado na declaração dos pesquisadores e na PB. Os pesquisadores confirmaram o nome completo da pesquisadora Talita e qual o vínculo institucional (Doutoranda, Pós-doutoranda, etc.) da mesma pesquisadora, pois a informação é conflitante entre a capa do projeto de pesquisa e o CV Lattes.

Delineamento da pesquisa: Trata-se de estudo transversal, observacional, baseado em arquivo, para o qual será realizado levantamento nos registros e laudos de 500 exames periciais de estimativa de idade realizados em indivíduos vivos, com idades estimadas entre 0 e 100 anos, periciados no Instituto de Medicina Legal de Porto Velho, Rondônia, no período entre janeiro de 2010 e dezembro de 2019.



Continuação do Parecer: 3.772.553

reunião de 13/02/2019. Será submetido para homologação na reunião de 13/02/2020.

**Este parecer foi elaborado baseado nos documentos abaixo relacionados:**

| Tipo Documento  | Arquivo   | Postagem               | Autor                               | Situação |
|---|---|------------------------|-------------------------------------|----------|
| Informações Básicas do Projeto                            | PB_INFORMAÇÕES_BASICAS_DO_P<br>RQJETO_1375045.pdf | 13/12/2019<br>21:33:29 |                                     | Aceito   |
| Outros  | Respostaparecer.pdf                               | 13/12/2019<br>21:32:30 | Talita Lima de Castro<br>Espicalsky | Aceito   |
| Projeto Detalhado / Brochura Investigador                 | 2ProjetoAlterado.pdf                              | 13/12/2019<br>21:30:19 | Talita Lima de Castro<br>Espicalsky | Aceito   |
| Outros  | CEPcompleto.pdf                                   | 06/12/2019<br>14:23:35 | Leny Cecilia Faro<br>Pereira        | Aceito   |
| Outros  | 55AutArq.pdf                                      | 20/11/2019<br>21:56:27 | Talita Lima de Castro               | Aceito   |
| Declaração de Instituição e Infraestrutura                | 52DeclInstituicao.pdf                             | 20/11/2019<br>21:54:39 | Talita Lima de Castro               | Aceito   |
| Declaração de Pesquisadores                               | 51DeclaraPesquisadores.pdf                        | 20/11/2019<br>21:54:20 | Talita Lima de Castro               | Aceito   |
| TCLE / Termos de Assentimento / Justificativa de Ausência | 4TCLE.pdf   | 20/11/2019<br>21:53:52 | Talita Lima de Castro               | Aceito   |
| Outros  | 3Comentarios.pdf                                  | 20/11/2019<br>21:51:45 | Talita Lima de Castro               | Aceito   |
| Folha de Rosto  | 1FolhadeRosto.pdf                                 | 20/11/2019<br>21:47:49 | Talita Lima de Castro               | Aceito   |

**Situação do Parecer:**

Aprovado

**Necessita Apreciação da CONEP:**

Não

## ANEXO 3 - Relatório de Verificação de Originalidade

### ESTIMATIVA DE IDADE EM INDIVÍDUOS VIVOS: CARACTERÍSTICAS E CASUÍSTICA

#### RELATÓRIO DE ORIGINALIDADE

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