

# Root Dentin Translucency and estimation age-at-death in adults using single-rooted teeth: Update of the Forensic International Dental Database.

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## INTRODUCTION

In 1992, Lamendin and colleagues introduced a novel procedure for estimating age-at-death using Root Dentin Translucency as the main estimation variable. Its applicability has been positively verified in various populations of the world, although with certain limitations.

In 2020, Parra and colleagues used the Lamendin technique and modified the original method by constructing a Bayesian algorithm. They developed a Database that they called Forensic International Dental Database (FIDB), which was implemented with 693 observations from the USA, Peru, Colombia and Spain. Garizoain and colleagues recently expanded the FIDB to 1,793 observations from different Latin American countries such as Argentina, Ecuador, Guatemala, Mexico, Peru and Colombia.

The authors have reported that the FIDB contributes to understanding the behavior of Root Dentin Translucency (RDT) and Periodontal Retraction (RP) as physiological indicators for estimating age, knowing the margins of error in the estimates and strengthening the statistical calculations implemented. So far, the authors have suggested that the combination of RDT and RP represents a useful, simple and positively applicable method for any population in the world.

## OBJECTIVE

This communication updates and expands the FIDB to a new calculation version (FIDBv2) which includes a greater incorporation of data from various countries around the world. The main objective of this report is to test the levels of precision and accuracy when using the total of the FIDBv2 versus the specific FIDB for each population, in a control sample from Peru, Colombia and Greece.

## MATERIALS AND METHODS

Currently, the sample size of the FIDBv2 has been substantially increased. FIDBv2 has a total of 3,482 individuals from Colombia, Perú, Portugal, México, Argentina, Guatemala, Ecuador, Brazil, Spain, United States of America, France, Greece, Italy and India. The mean chronological age of the individuals in the FIDBv2 is 51.95 years, ranging from 20 to 99 years old. Regarding sex, 1,340 individuals are female and 2,142 are male. Three control samples were used for the evaluation of the proposal by Parra et al., 2020. The first one consists of 112 Colombian individuals, the second of 82 Peruvian individuals and the third of 100 Greek individuals. Table 1 shows the distribution by sex of the control samples according to the population of origin.

Table 1. Distribution by sex and country of origin (years).

	Females				Males				Total	
	N	Mean	Median	N	Mean	Median	N	Mean	Median	
Grecia	51	55.52	53	49	54.20	55	100	54.88	53.50	
Peru	17	41.82	40.00	65	40.78	40.00	82	41.00	40.00	
Colombia	16	40.68	33.50	96	40.40	37.00	112	40.44	37.00	

All measurements were carried out following the original proposal of Lamendin et al., 1992.

The estimates were calculated taking the total FIDBv2 and the specific FIDB for Colombia, Peru and Greece as references. Age estimates were calculated using the model of Parra et al. 2020, with R software version 4.01, and the statistical analyzes were performed using IBM SPSS version 24.0.

The results were analyzed in a general way and by age cohorts. For each case, the age estimation interval was calculated using the standard error of the estimates following Parra et al., 2020. The number of times that the chronological age of the individuals was located within the constructed interval was quantified, evidencing a correct estimation of age.

## RESULTS

### Colombian control sample

Taking the FIDBv2 as a reference, the results of the estimations did not offer statistically significant differences (Wilcoxon's Test: Z = 1.56; P = 0.11). The bias in the estimates was 1.99 years and the imprecision was 7.35. (Table 2). When taking the Colombian FIDB as a reference, the differences between the estimated and the documented age were statistically significant (Z = -3.43; P = 0.01). The bias and the imprecision of the estimates were -3.41 and 8.58 years, respectively. (Table 3).

Table 2. Colombian sample estimates FIDBv2 as reference

Age Group	N	Mean estimated age	Bias	Accuracy	% of Correct estimates	K	p
20-30	28	31.38	-4.13	6.53	96.4%(27)	2.93	0.00**
31-40	39	39.97	-5.30	7.51	89.7%(35)	3.54	0.00**
41-50	21	41.89	3.81	7.17	95.2%(20)	-2.19	0.02*
51-60	14	53.05	2.23	5.09	100%(14)	-1.22	0.22
61-70	6	60.30	4.20	9.93	100%(6)	-1.15	0.24
71-80	4	63.17	10.82	16.47	75%(3)	-1.09	0.27
>80	-	-	-	-	-	-	-

Table 3. Colombian control sample estimates FIDB Colombian subsample as reference

Age Group	N	Mean estimated age	Bias	Accuracy	% of Correct estimates	K	p
20-30	28	24.20	3.04	6.88	78.6%(22)	-1.41	0.15
31-40	39	35.06	-0.45	7.66	84.6%(33)	-0.32	0.74
41-50	21	37.21	8.94	11.21	76.2%(16)	-2.90	0.00**
51-60	14	51.12	4.14	6.58	100%(14)	-1.60	0.10
61-70	6	59.15	5.35	12.08	100%(6)	-1.15	0.24
71-80	4	62.42	11.57	17.42	75%(3)	-1.09	0.27
>80	-	-	-	-	-	-	-

## RESULTS

### Peruvian control sample

The differences between the estimated and the documented age were not statistically significant (Wilcoxon's Test: Z = -1.81; P = 0.061) when the FIDBv2 was taken as a reference. The estimates show a bias of 1.62 years and an imprecision of 5.80. (Table 4). When the calculations were made with the Peruvian FIDB reference, the differences between the estimated and the documented age were not statistically significant either (Wilcoxon's Test: Z = -1.81; p = 0.06), with a mean error of -1.64 (bias) and 5.82 years (imprecision). (Table 5).

Table 4. Peruvian sample estimates FIDBv2 as reference

Age Group	N	Mean estimated age	Bias	Accuracy	% of Correct estimates	K	p
20-30	13	32.58	-5.50	5.50	100%(13)	3.18	0.01*
31-40	26	36.51	-3.44	3.21	100%(26)	1.57	0.11
41-50	21	40.72	4.74	5.32	100%(21)	-3.80	0.00**
51-60	21	46.79	6.98	10.11	88.9%(18)	-2.70	0.00**
61-70	1	48.90	17.10	17.10	100%(1)	1.00	0.31
71-80	-	-	-	-	-	-	-
>80	-	-	-	-	-	-	-

Table 5. Peruvian control sample estimates FIDB Peruvian subsample as reference

Age Group	N	Mean estimated age	Bias	Accuracy	% of Correct estimates	K	p
20-30	13	33.31	-6.23	6.23	100%(13)	3.18	0.01*
31-40	26	36.12	-1.62	3.23	100%(26)	1.65	0.09
41-50	21	40.07	4.16	6.72	100%(21)	-3.54	0.00**
51-60	21	45.94	7.29	9.36	100%(21)	-3.25	0.00**
61-70	1	48.30	17.70	17.70	100%(1)	1.00	0.31
71-80	-	-	-	-	-	-	-
>80	-	-	-	-	-	-	-

### Greek control sample

When taking the FIDBv2 as a reference, the differences between the estimated and the documented age were statistically significant (Wilcoxon's test: Z = 2.53; P = 0.01) with a bias of 3.70 years and an imprecision of 9.51 years. (Table 6). Regarding the estimates obtained using the Greek FIDB reference sample, the differences between the estimated and the documented age were not statistically significant (Wilcoxon's test: Z = -0.19; p = 0.84), with mean errors of 0.74 (bias) and 8.63 years (imprecision). (Table 7).

## RESULTS

Table 6. Greek sample estimates FIDBv2 as reference

Age Group	N	Mean estimated age	Bias	Accuracy	% of Correct estimates	K	p
20-30	15	35.07	-9.87	9.87	86.7%(13)	3.40	0.00**
31-40	14	38.86	-3.79	5.26	92.9%(13)	1.97	0.04*
41-50	16	44.41	1.08	4.34	100%(16)	-0.46	0.64
51-60	14	54.94	0.12	6.35	100%(14)	-0.28	0.77
61-70	14	55.19	9.73	10.39	100%(14)	-3.10	0.00**
71-80	14	65.35	11.00	11.66	92.9%(13)	-2.90	0.00**
>80	13	68.72	20.20	20.20	61.5%(8)	-3.50	0.00**

Table 7. Greek control sample estimates Greek FIDB subsample as reference

Age Group	N	Mean estimated age	Bias	Accuracy	% of Correct estimates	K	p
20-30	15	32.56	-1.76	7.80	86.7%(13)	3.38	0.00**
31-40	14	37.95	-2.88	6.05	92.9%(13)	1.06	0.28
41-50	16	45.01	0.48	5.08	100%(16)	-0.20	0.83
51-60	14	58.90	-3.82	7.88	85.7%(12)	1.34	0.18
61-70	14	58.65	6.27	9.79	100%(14)	-1.97	0.04
71-80	14	71.77	3.58	11.75	92.9%(13)	-0.81	0.41
>80	13	78.23	10.69	12.96	76.9%(10)	-2.41	0.01

## DISCUSSION & CONCLUSION

- The age estimates showed similar results when using the total FIDBv2 and the specific FIDBv2 for each control population. The results suggest that there are no substantial differences when using a specific model for each population versus using a generalizable model.
- In almost all age groups of the control samples, the percentages of correct estimates were greater than 75%. The Peruvian FIDBv2 correctly predicted the age in 100% of the cases.
- In general, the results of the age estimates using both the total and the specific FIDBv2 reported less than 10 years of error for individuals aged 31-60 years.
- The updated FIDBv2 provides good results to be used on a global scale, as originally suggested by Parra and colleagues (2020). This forensic procedure could be incorporated in several contexts around the world.
- The results are optimal in terms of precision and accuracy, and it has also been possible to reduce the "trajectory effect". The calculation system, including the FIDBv2, will be available online soon.

## ACKNOWLEDGMENTS

The authors of this article want to acknowledge the Humanitarian and Human Rights Resource Center of the American Academic of Forensic Science and the National Institute of Justice through their Forensic Technology Center of Excellence Program, RTI International of U.S. Department of Justice by sponsorship provided.

## REFERENCES AVAILABLE UPON REQUEST

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