ESTIMATION OF ANCESTRY USING MESIODISTAL, BUCCOLINGUAL AND DIAGONAL TOOTH MEASUREMENTS

A Research Project

Submitted to the

Forensic Science, Forensic Research Committee

George Mason University

in Partial Fulfilment of

The Requirements for the Degree

of

Master of Science

Forensic Science

By

Shraddha M Navale

Department of Forensic Science

George Mason University

Fairfax – VA -22030

Fall'2019

Primary Research Advisor

Dr Anthony B. Falsetti

Associate Professor

GMU Forensic Science Program

Secondary Research Advisor

Dr. M.S. Rani

Professor & Head of the Department of Orthodontics, V.S.Dental College & Hospital

Currently working as an Orthodontist, Dental Clinics of Jayanagar,Bangalore – INDIA

GMU Graduate Research Coordinator

Dr. Joseph A. DiZinno

Assistant Professor

GMU Forensic Science Program

Fall Semester 2019

George Mason University

Fairfax, VA

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Primary Research Advisor

Dr Anthony B. Falsetti,

Associate Professor

GMU Forensic Science Program

GMU Graduate Research Coordinator

Dr. Joseph A. DiZinno

Assistant Professor

GMU Forensic Science Program

CERTIFICATE

Certified that this research project '**Estimation of Ancestry Using Mesiodistal, Buccolingual And Diagonal Tooth Measurements'** is the product of bonafide investigation carried out by the student SHRADDHA M NAVALE, under our guidance and supervision and that it is worthy of consideration for the **Partial Fulfilment of The Requirements for the Degree of Master of Science, Forensic Science.**

Primary Research Advisor	**Graduate Research Coordinator**
Dr Anthony B. Falsetti,	**Dr. Joseph A. DiZinno**
Associate Professor	Assistant Professor
GMU Forensic Science Program	GMU Forensic Science Program

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Shraddha M Navale

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I. ABSTRACT:

In forensic science, when an individual is to be identified, in most of the cases, teeth are considered the precious and reliable tool for observation and analysis owing to the fact that they are the hardest tissue and the only last tissue to decompose in the body, they are multi-rooted ones akin the premolars and molars and also one single rooted tooth – the canine, attributable to the fact that it has the longest root and therefore better allow for better anchorage. Keeping this in mind, this project aims at being able to estimate ancestry from the dental data collected viz: the crown measurements mesiodistally, buccolingually, diagonally and vertically such as the crown height, namely. And in this research, it can be achieved by physically measuring dental diagnostic casts using digital calipers and then analyzing the data generated from it using Discriminant Function Analysis. The interpretation and conclusion expected from this analysis is to be able to classify the dimensions of the teeth as per their ancestral line.

II. INTRODUCTION;

Can teeth tell us the ancestry of a deceased individual? If so, can we classify them in ranges for each ancestral line? As a tooth is the last piece of evidence to decompose in a body, resistant to taphonomical degradation and postmortem insults (P.Sharma, Singh, Kumar, Chandra & R.Sharma, 2013), it is beneficial to assimilate as much data as possible from it. The purpose and aim of this study is to be able to estimate ancestry from the dental data collected viz: the crown measurements mesiodistally, buccolingually, diagonally and vertically such as the crown height, in

millimeters. In this research, it can be achieved by physically measuring 100 dental diagnostic casts using digital calipers calibrated at 0.00mm and then analyzing the data generated from it using Discriminant Function Analysis. Out of the 100 casts measured, 50 were female and 50 were male.

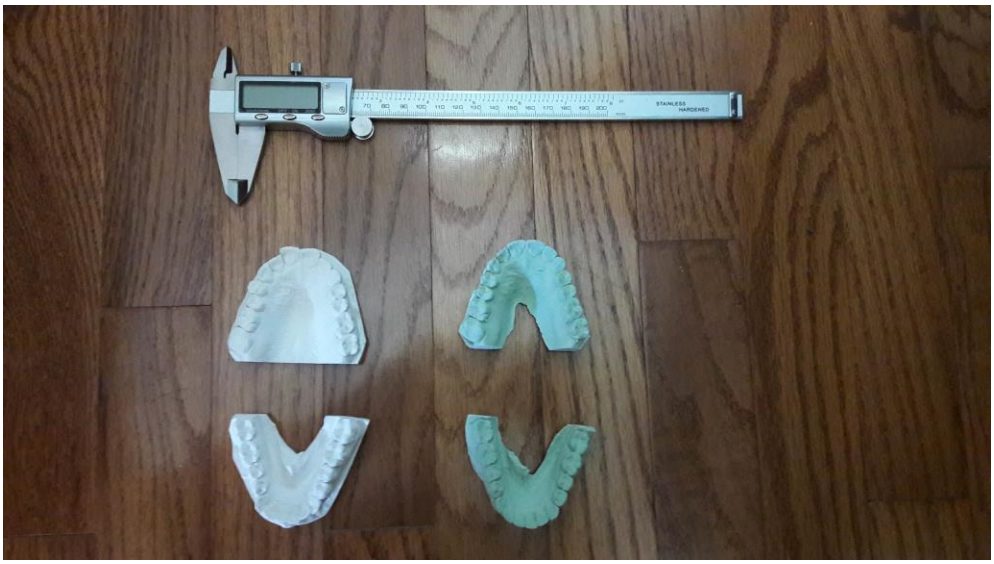
III. BODY OF TEXT :

As followed by Pilloud et al (2014), this study too has excluded the measurements of the third molars as they are highly variable and are often congenitally missing. In the current project being carried out, the teeth that are mostly found in the forensic cases which are not lost easily, are being taken into consideration for mensuration, which are 5 in each quadrant and a total of 20 in each permanent dentition, unlike the literature which measured all the teeth which are 28 excluding the third molars (Pilloud et al, 2014). When the sex of the individual is known, either by the dental morphology or the cranial and pelvic dimorphism, the success rates are ranged between 76% and 92.5% (Nadendla, Paramkusam, Pokala & Devulapalli, 2016), 53.8% and 63.6% (Peckmann et al, 2015) and 71.9% to 88.1% (Pilloud et al, 2014).

IV. METHODS AND MATERIALS :

Diagnostic dental casts, of anonymous individuals, which are considered as existing data for measurements were obtained from a local dentist's office and measured using digital calipers with a calibration of 0.00mm. Since the dental casts

are replicas of the individuals dentition, it is expected to give the similar results as and when, if the dentition of human subjects were to be examined in person. The measurements include mesiodistal, buccolingual, diagonal/occlusal and crown height, namely. Few variables considered for this project are the sex of the individual, type of teeth being adult permanent dentition and the ancestral lineage self – reported by the individual that they want to be identified as. The data is expected to be generated from a sample size of 100 casts which include casts from individuals before orthodontic treatment and after orthodontic treatment, enabling the use of another variant in this process, time of the replica fabricated.



V. DATA ANALYSIS AND INTERPRETATION;

The data, in this instance being the measurements, were generated from diagnostic dental casts and measured using digital calipers with a calibration of 0.00mm. The measurements include mesiodistal, buccolingual, diagonal/occlusal and crown height, namely. The data is expected to be then analyzed using the

discriminant function analysis and ANOVA(Analysis of Variance) statistical analysis for group classification and dental variation (Pilloud, Hefner, Hanihara & Hayashi, 2014). The significance and importance of this study is to be able to provide different ancestral group classifications along with possible different tooth dimension ranges for each of those groups respectively.

Two independent variables were considered namely sex and ancestry, 2 types and 11 types respectively. Five dependent variables were then considered namely, buccolingual, mesiodistal, incisal, occlusal and crown height measurements. Buccolingual measurement refers to the aspect measured from the surface in contact with the lip or cheek to the surface in contact with the tongue. Mesiodistal measurement refers to the measurement from the surface of the tooth towards the midline of the dentition to the surface of the tooth farther away from the midline. Incisal measurement refers to the measurement of the cutting edges of the anterior tooth such as the canines in this research project. Occlusal measurement refers to the measurement of the chewing surface of the posterior teeth such as the premolars and molars. Crown height is measured from the incisal or occlusal surface to the neck of the tooth precisely the clinical crown of the tooth. The ancestries include 26 Whites, 28 Blacks, 14 Indians, 1 Indian Sikh, 1 Iranian, 10 Latino, 5 Pakistanis, 3 Italians, 9 Admixed and 3 Srilankans.

Class Level Information		
Class	**Levels**	**Values**
Sex	2	F M
Ancestry	11	Admixed Black Indian Indian/I Indian/S Italian Italian/ Latino Pakistan Srilankan White

Data for Analysis of Mesiodistal Buccolingual CrownHeight	
Number of Observations Read	196
Number of Observations Used	196

Data for Analysis of Occlusal	
Number of Observations Read	196
Number of Observations Used	1

Data for Analysis of Incisal	
Number of Observations Read	196
Number of Observations Used	195

Note : Variables in each group are consistent with respect to the presence or absence of missing values.

The GLM Procedure

Dependent Variable: Mesiodistal

Group3=1 C

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	14	19.6843536	1.4060253	3.11	0.0002
Error	181	81.7582464	0.4517030		
Corrected Total	195	101.4426000			

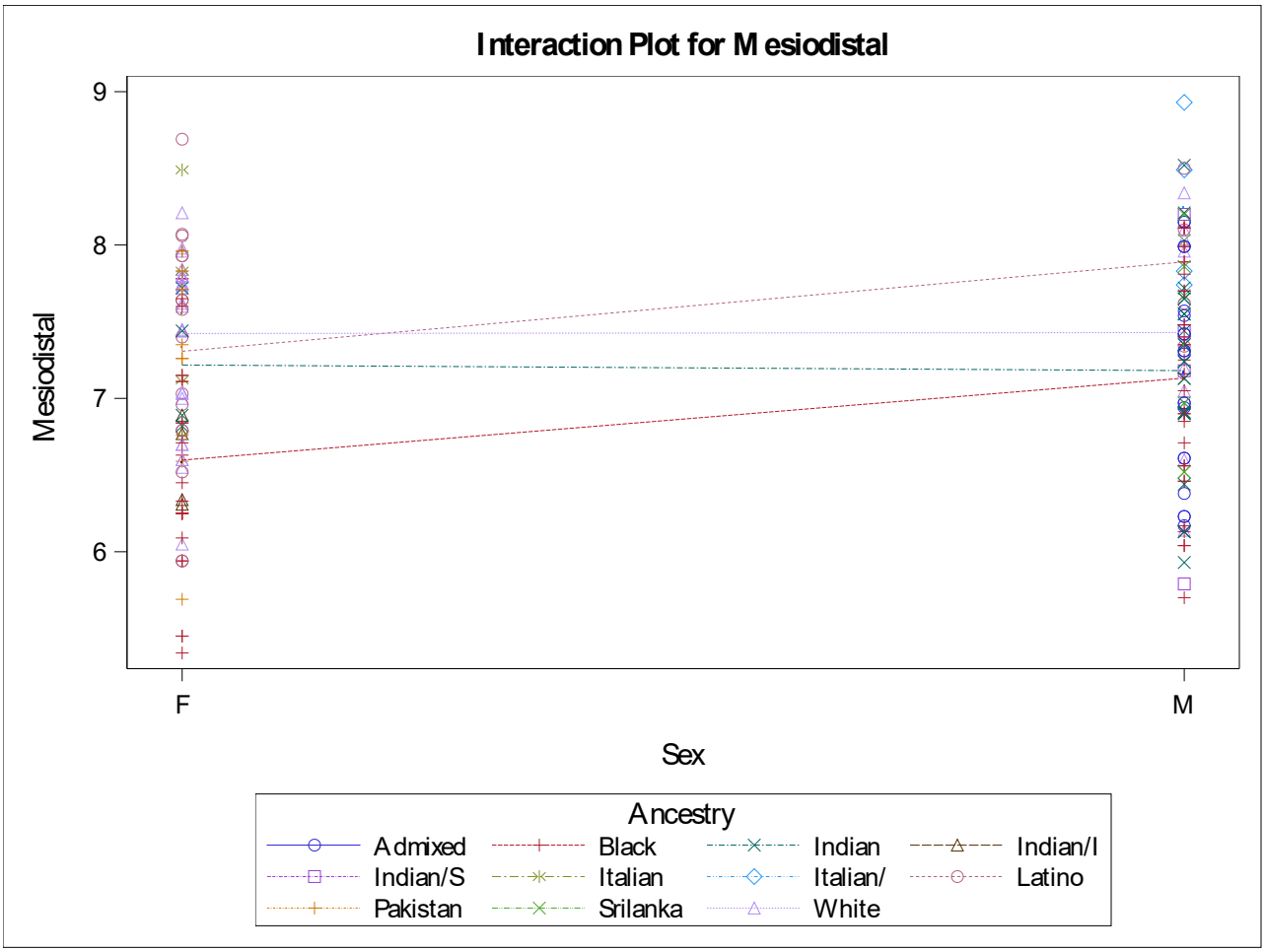
R-Square	Coeff Var	Root MSE	Mesiodistal Mean
0.194044	9.329010	0.672089	7.204286

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Sex	1	1.40783550	1.40783550	3.12	0.0792
Ancestry	10	16.00809988	1.60080999	3.54	0.0003
Sex*Ancestry	3	1.89751657	0.63250552	1.40	0.2443

The GLM Procedure

Dependent Variable: Mesiodistal

Group3=1 C



According to the model of the analysis procedure as is, there is much significance in the mesiodistal measurements of the canine as the values of the probability for the given F ratio, Pr > F, after sum of squares,are of very less values. When the type 3 sum of squares is calculated and considered, the variable – sex does not show much significance with respect to this particular measurement, whereas the variable – ancestry shows prominent significance and interactions as the values are less than .05.The interaction between sex and ancestry is prominently not significant as the probability values do not lie within .05.

The GLM Procedure

Dependent Variable: Buccolingual

Group3=1 C

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	14	30.9400972	2.2100069	4.55	<.0001
Error	181	87.8693559	0.4854661		
Corrected Total	195	118.8094531			

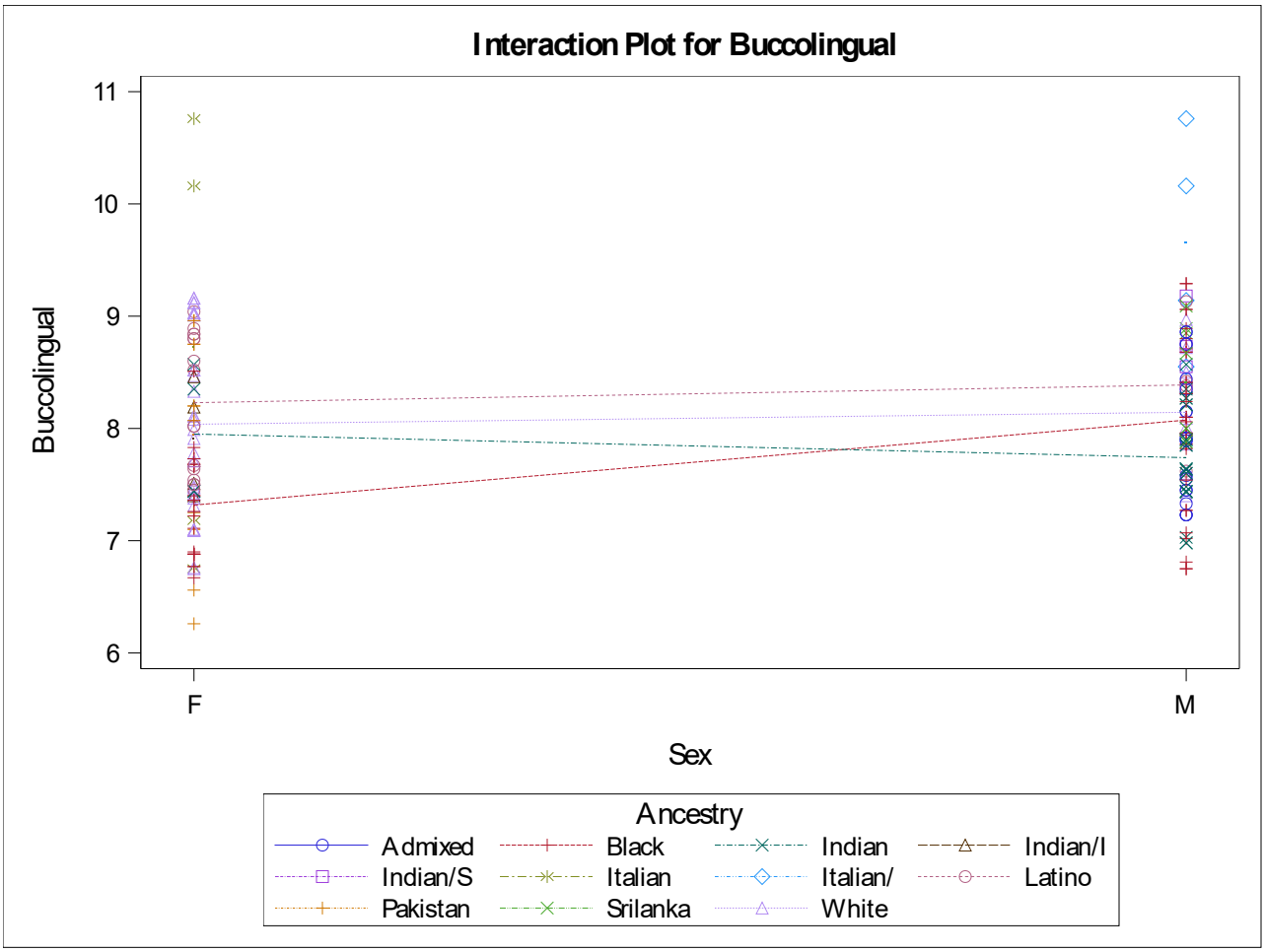
R-Square	Coeff Var	Root MSE	Buccolingual Mean
0.260418	8.705205	0.696754	8.003878

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Sex	1	0.78367016	0.78367016	1.61	0.2055
Ancestry	10	22.61886194	2.26188619	4.66	<.0001
Sex*Ancestry	3	3.73801603	1.24600534	2.57	0.0560

The GLM Procedure

Dependent Variable: Buccolingual

Group3=1 C



According to the model of the analysis procedure as is, there is much significance in the buccolingual measurements of the canine as the values of the probability for the given F ratio, Pr > F, after sum of squares,are of very less values. When the type 3 sum of squares is calculated and considered, the variable – sex does not show much significance with respect to this particular measurement, whereas the variable – ancestry shows prominent significance and interactions as the values are less than .05.The interaction between sex and ancestry may be slightly significant as the probability values are close to .05 .

The GLM Procedure

Dependent Variable: CrownHeight

Group3=1 C

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	14	53.7194791	3.8371056	4.57	<.0001
Error	181	152.0361021	0.8399785		
Corrected Total	195	205.7555811			

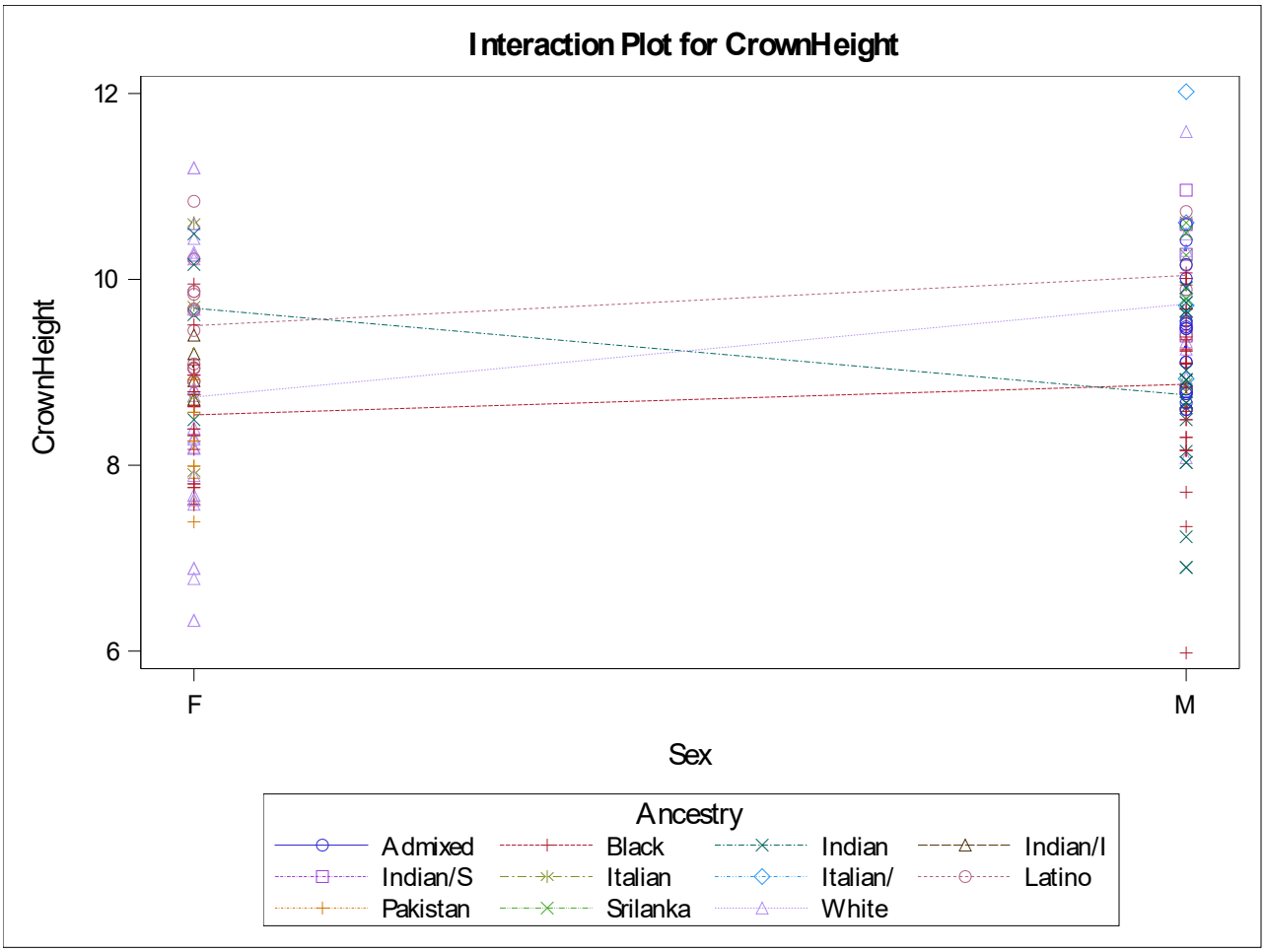
R-Square	Coeff Var	Root MSE	CrownHeight Mean
0.261084	10.14535	0.916503	9.033724

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Sex	1	1.05067552	1.05067552	1.25	0.2649
Ancestry	10	37.55591627	3.75559163	4.47	<.0001
Sex*Ancestry	3	8.37647424	2.79215808	3.32	0.0210

The GLM Procedure

Dependent Variable: CrownHeight

Group3=1 C



According to the model of the analysis procedure as is, there is much significance in the crown height measurements of the canine as the values of the probability for the given F ratio, Pr > F, after sum of squares,are of very less values. When the type 3 sum of squares is calculated and considered, the variable – sex does not show much significance with respect to this particular measurement, whereas the variable – ancestry shows prominent significance and interactions as the values are less than .05.The interaction between sex and ancestry may be slightly significant as the probability values lie within .05 .

The GLM Procedure

Dependent Variable: Occlusal

Group3=1 C

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	0	0	.	.	.
Error	0	0	.		
Corrected Total	0	0			

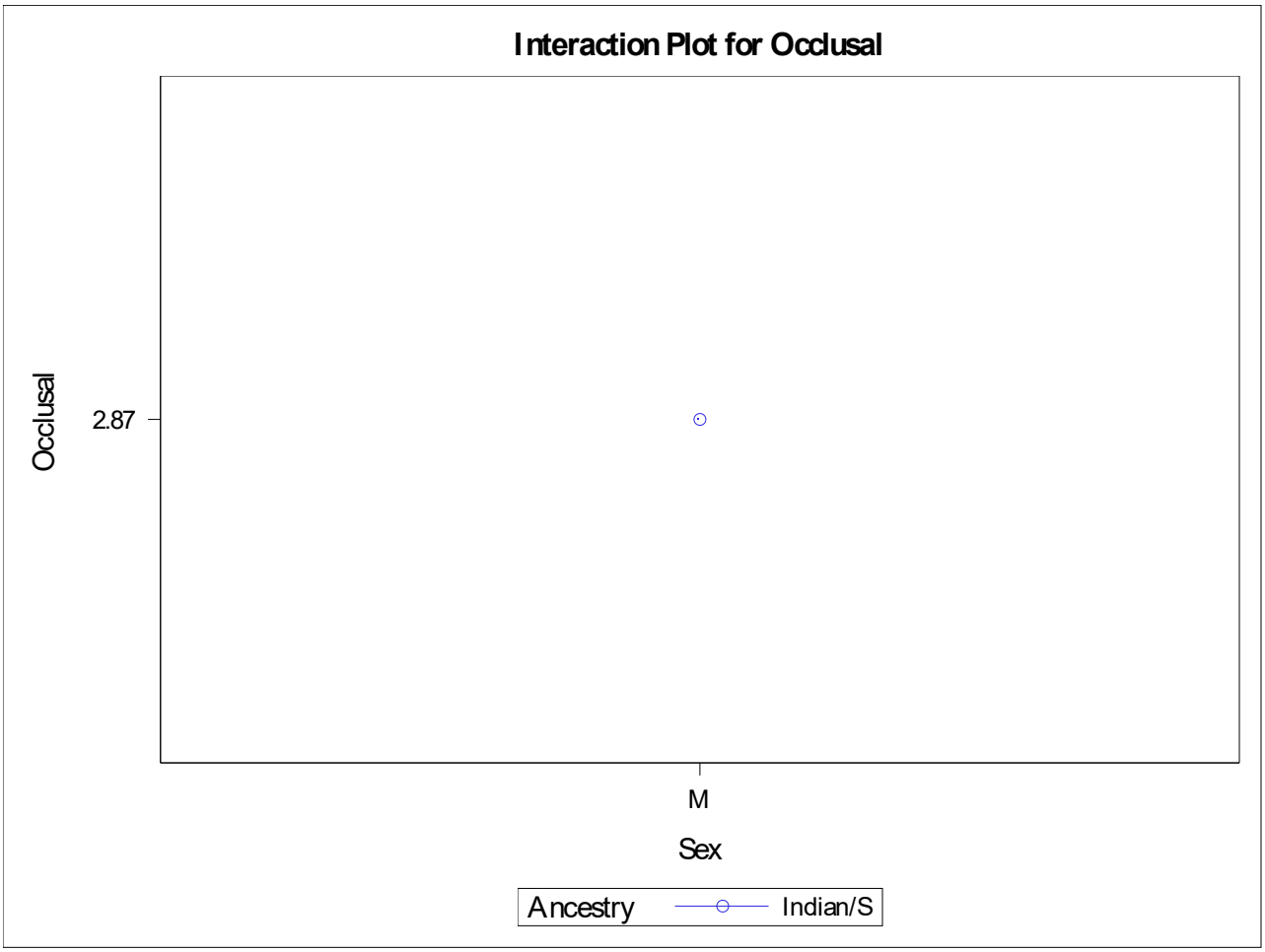
R-Square	Coeff Var	Root MSE	Occlusal Mean
0.000000	.	.	2.870000

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Sex	0	0	.	.	.
Ancestry	0	0	.	.	.
Sex*Ancestry	0	0	.	.	.

The GLM Procedure

Dependent Variable: Occlusal

Group3=1 C



Since the cutting and chewing surface of anterior teeth such as the canines, are known as incisal edges and occlusal surfaces are solely meant for those of the posterior teeth, the canine does not have an occlusal measurement.

The GLM Procedure

Dependent Variable: Incisal

Group3=1 C

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	14	17.94120321	1.28151452	9.04	<.0001
Error	180	25.51726140	0.14176256		
Corrected Total	194	43.45846462			

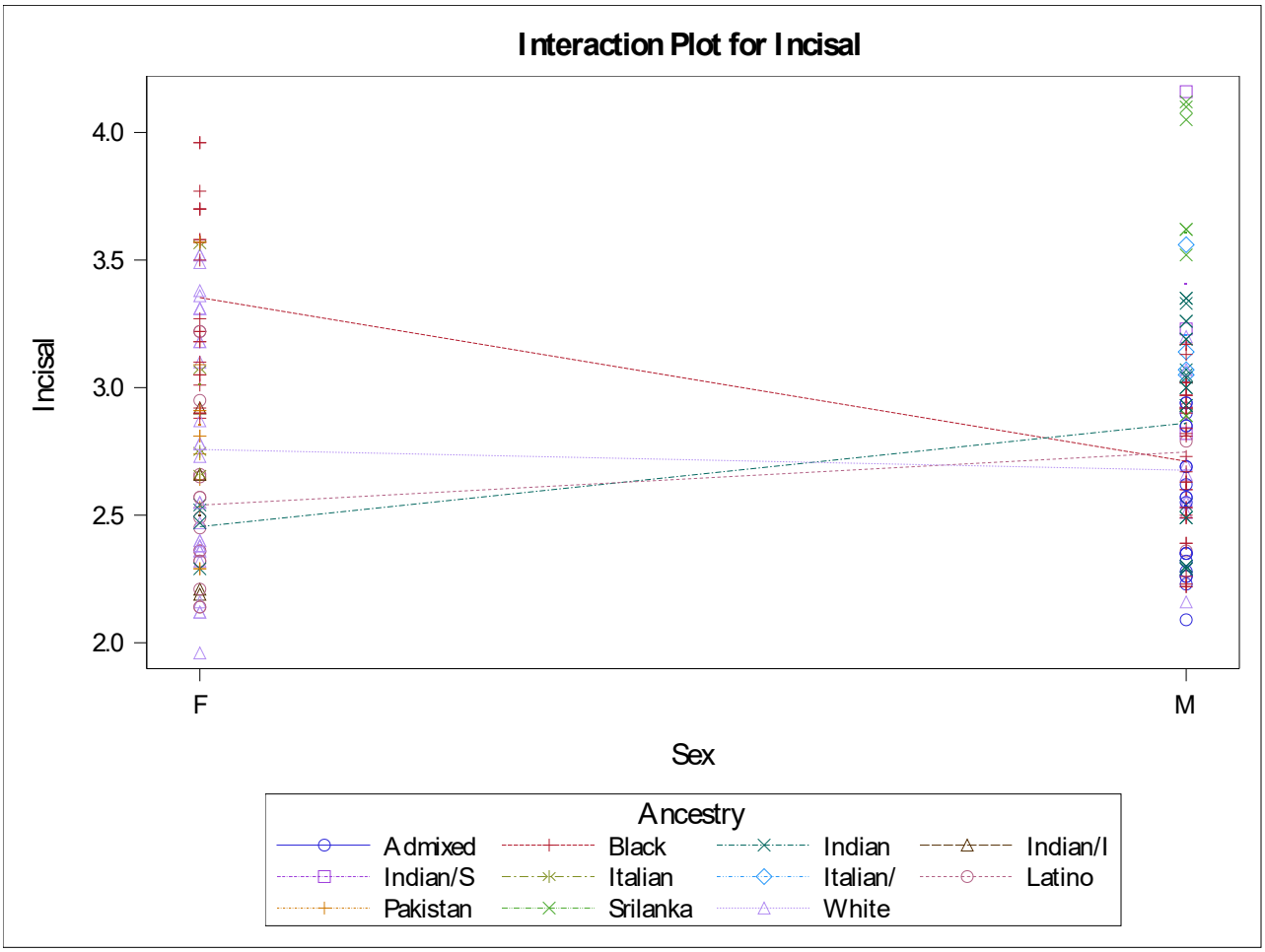
R-Square	Coeff Var	Root MSE	Incisal Mean
0.412836	13.24246	0.376514	2.843231

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Sex	1	0.01417025	0.01417025	0.10	0.7522
Ancestry	10	11.68944913	1.16894491	8.25	<.0001
Sex*Ancestry	3	4.39656044	1.46552015	10.34	<.0001

The GLM Procedure

Dependent Variable: Incisal

Group3=1 C



According to the model of the analysis procedure as is, there is much significance in the incisal measurements of the canine as the values of the probability for the given F ratio, Pr > F, after sum of squares,are of very less values. When the type 3 sum of squares is calculated and considered, the variable – sex does not show much significance with respect to this particular measurement, whereas the variable – ancestry shows prominent significance and interactions as the values are less than .05.The interaction between sex and ancestry is also prominently significant as the probability values lie well within .05 .

The GLM Procedure

Group3=1 M1

Class Level Information		
Class	**Levels**	**Values**
Sex	2	F M
Ancestry	11	Admixed Black Indian Indian/I Indian/S Italian Italian/ Latino Pakistan Srilankan White

Data for Analysis of Incisal	
Number of Observations Read	196
Number of Observations Used	0

Data for Analysis of Mesiodistal Buccolingual CrownHeight Occlusal	
Number of Observations Read	196
Number of Observations Used	196

Note: Variable in each group are consistent with respect to presence or absence of missing values.

The GLM Procedure

Dependent Variable: Mesiodistal

Group3=1 M1

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	14	20.9446684	1.4960477	1.98	0.0219
Error	181	137.1019454	0.7574693		
Corrected Total	195	158.0466138			

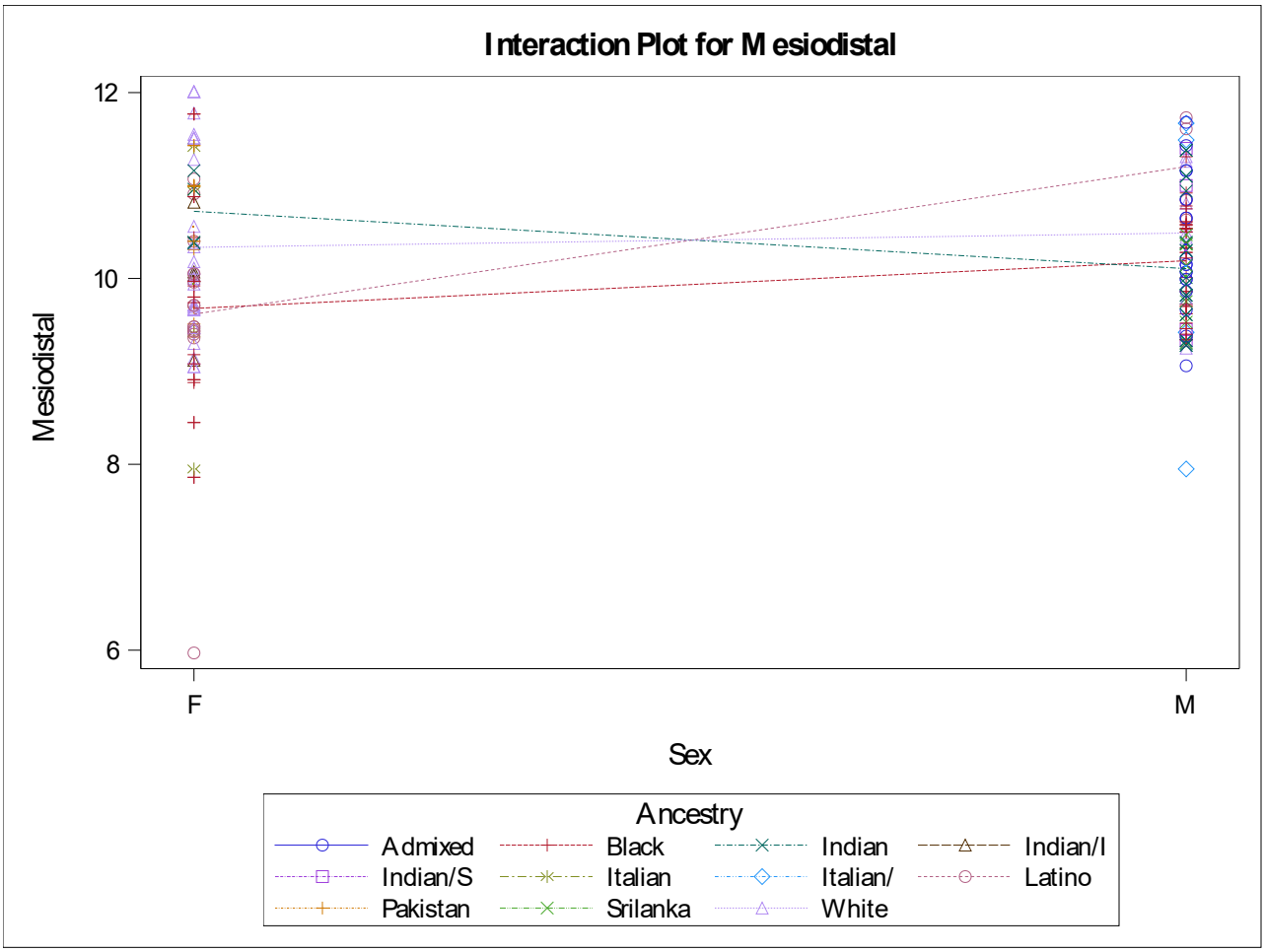
R-Square	Coeff Var	Root MSE	Mesiodistal Mean
0.132522	8.565653	0.870327	10.16066

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Sex	1	3.19685403	3.19685403	4.22	0.0414
Ancestry	10	10.10034202	1.01003420	1.33	0.2156
Sex*Ancestry	3	8.55452520	2.85150840	3.76	0.0118

The GLM Procedure

Dependent Variable: Mesiodistal

Group3=1 M1



According to the model of the analysis procedure as is, there is much significance in the mesiodistal measurements of the first molar as the values of the probability for the given F ratio, Pr > F, after sum of squares,are of very less values. When the type 3 sum of squares is calculated and considered, the variable – ancestry does not show much significance with respect to this particular measurement, whereas the variable – sex shows prominent significance and interactions as the values are less than .05. The interaction between sex and ancestry is also prominently significant as the probability values lie well within .05 .

The GLM Procedure

Dependent Variable: Buccolingual

Group3=1 M1

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	14	42.9200871	3.0657205	7.05	<.0001
Error	181	78.7082108	0.4348520		
Corrected Total	195	121.6282980			

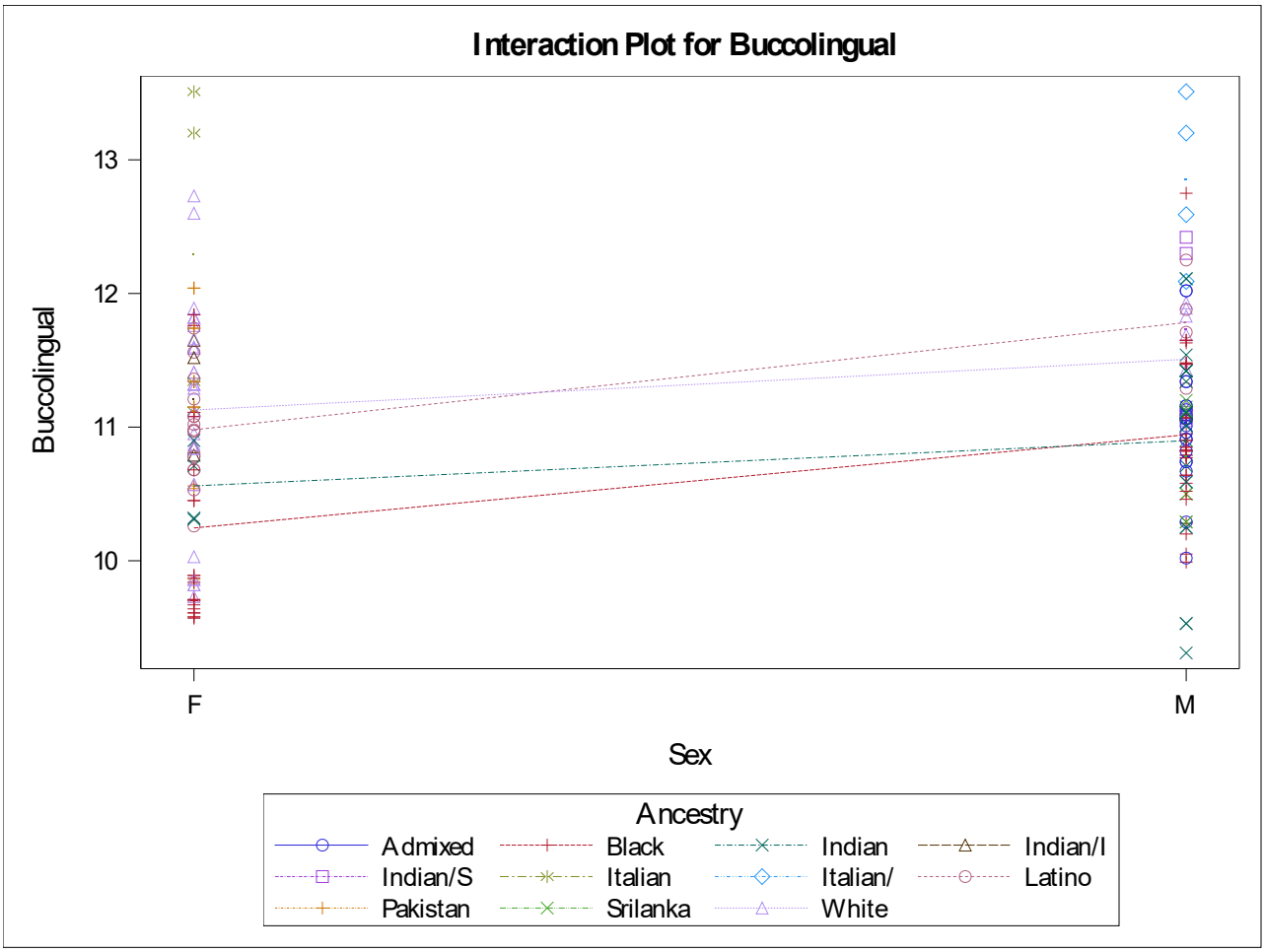
R-Square	Coeff Var	Root MSE	Buccolingual Mean
0.352879	5.986627	0.659433	11.01510

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Sex	1	5.86165693	5.86165693	13.48	0.0003
Ancestry	10	37.84089200	3.78408920	8.70	<.0001
Sex*Ancestry	3	0.7962468 7	0.26541562	0.61	0.6091

The GLM Procedure

Dependent Variable: Buccolingual

Group3=1 M1



According to the model of the analysis procedure as is, there is much significance in the buccolingual measurements of the first molar as the values of the probability for the given F ratio, Pr > F, after sum of squares,are of very less values. When the type 3 sum of squares is calculated and considered, the variable– sex and ancestry shows prominent significance and interactions with respect to this particular measurement as the values are less than .05.The interaction between sex and ancestry is not significant as the probability values do not lie within .05 .

The GLM Procedure

Dependent Variable: CrownHeight

Group3=1 M1

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	14	55.4969569	3.9640684	8.87	<.0001
Error	181	80.8532839	0.4467032		
Corrected Total	195	136.3502408			

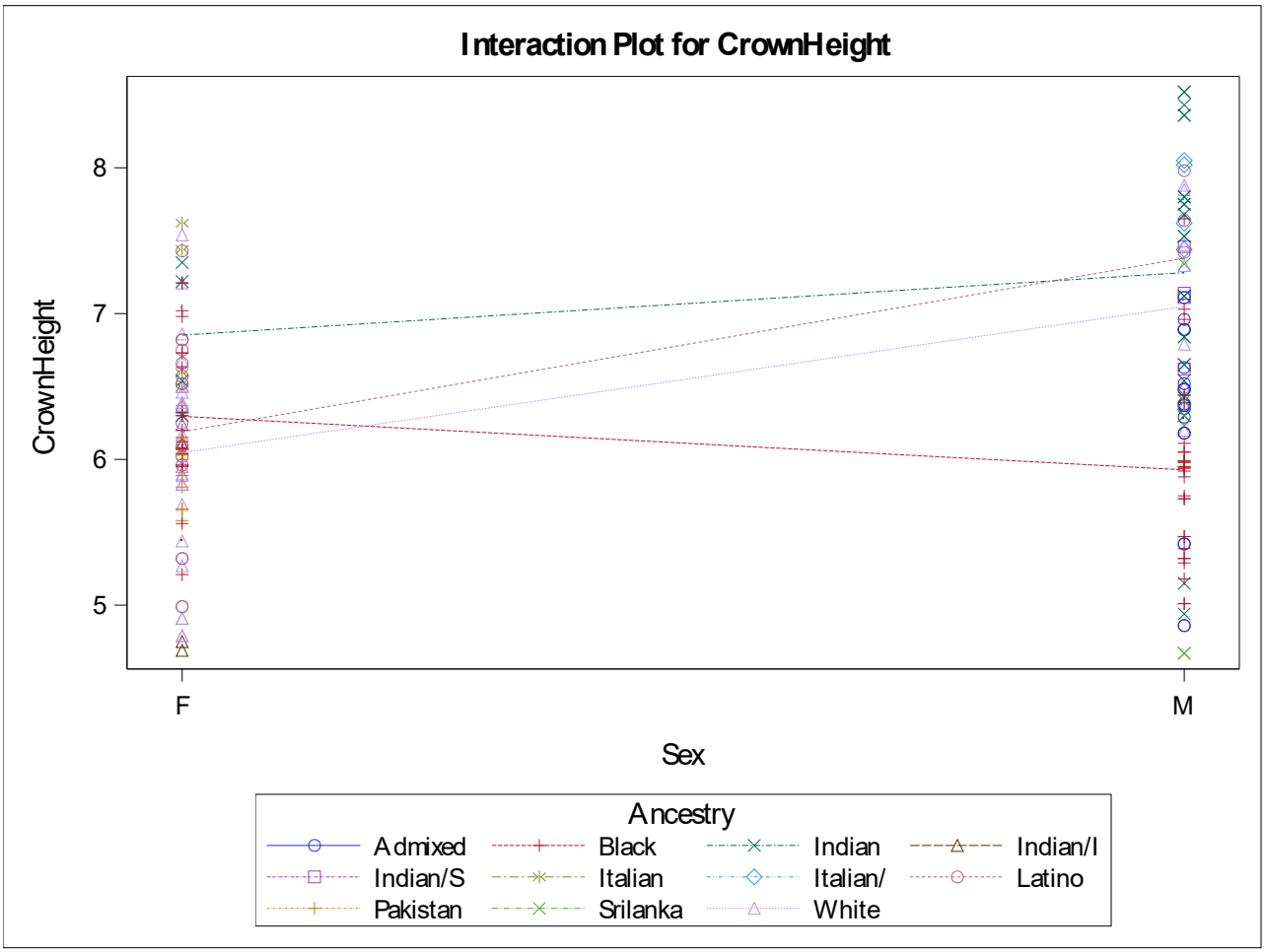
R-Square	Coeff Var	Root MSE	CrownHeight Mean
0.407018	10.48657	0.668359	6.373469

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Sex	1	6.05661173	6.05661173	13.56	0.0003
Ancestry	10	30.38976760	3.03897676	6.80	<.0001
Sex*Ancestry	3	11.74320141	3.91440047	8.76	<.0001

The GLM Procedure

Dependent Variable: CrownHeight

Group3=1 M1



According to the model of the analysis procedure as is, there is much significance in the crown height measurements of the first molar as the values of the probability for the given F ratio, Pr > F, after sum of squares,are of very less values. When the type 3 sum of squares is calculated and considered, the variable– sex and ancestry show prominent significance and interactions with respect to this particular measurement as the values are less than .05.The interaction between sex and ancestry is also prominently significant as the probability values do lie well within .05 .

The GLM Procedure

Dependent Variable: Occlusal

Group3=1 M1

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	14	25.9528730	1.8537766	3.17	0.0002
Error	181	106.0050372	0.5856632		
Corrected Total	195	131.9579102			

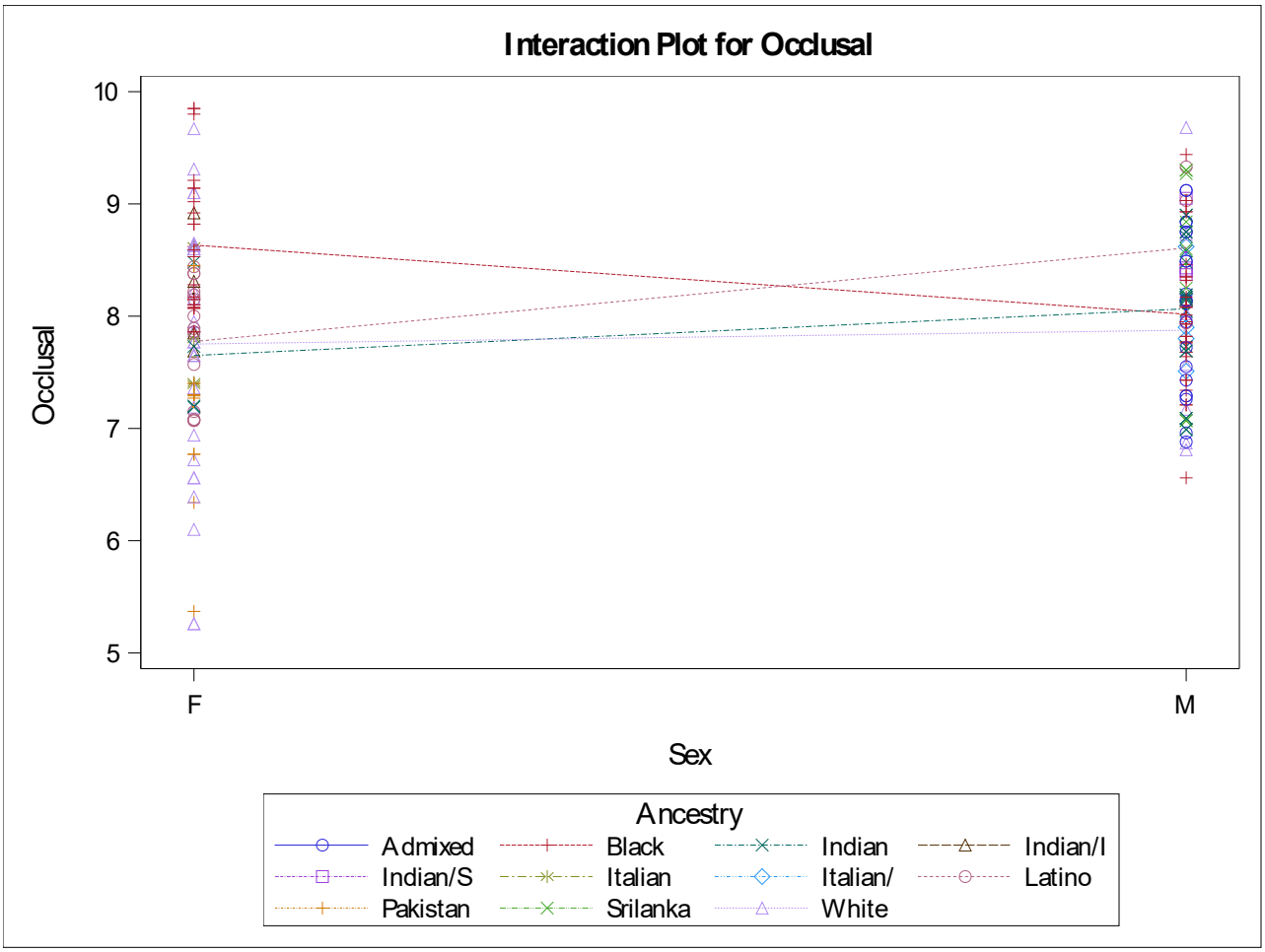
R-Square	Coeff Var	Root MSE	Occlusal Mean
0.196675	9.546110	0.765286	8.016735

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Sex	1	0.68200754	0.68200754	1.16	0.2820
Ancestry	10	15.22519861	1.52251986	2.60	0.0057
Sex*Ancestry	3	7.61872843	2.53957614	4.34	0.0056

The GLM Procedure

Dependent Variable: Occlusal

Group3=1 M1



According to the model of the analysis procedure as is, there is much significance in the occlusal measurements of the first molar as the values of the probability for the given F ratio, Pr > F, after sum of squares,are of very less values. When the type 3 sum of squares is calculated and considered, the variable – sex does not show much significance with respect to this particular measurement, whereas the variable – ancestry shows prominent significance and interactions as the values are less than .05.The interaction between sex and ancestry is also prominently significant as the probability values lie well within .05 .

The GLM Procedure

Group3=1 M2

Class Level Information		
Class	**Levels**	**Values**
Sex	2	F M
Ancestry	12	Admixed Black Indian Indian/I Indian/S Italian Italian/ Latino Pakistan Paksitan Srilankan White

Data for Analysis of Incisal	
Number of Observations Read	196
Number of Observations Used	0

Data for Analysis of Mesiodistal Buccolingual CrownHeight Occlusal	
Number of Observations Read	196
Number of Observations Used	195

Note: Variable in each group are consistent with respect to the presence or absence of missing values.

The GLM Procedure

Dependent Variable: Mesiodistal

Group3=1 M2

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	15	26.0226770	1.7348451	2.76	0.0007
Error	179	112.5511692	0.6287775		
Corrected Total	194	138.5738462			

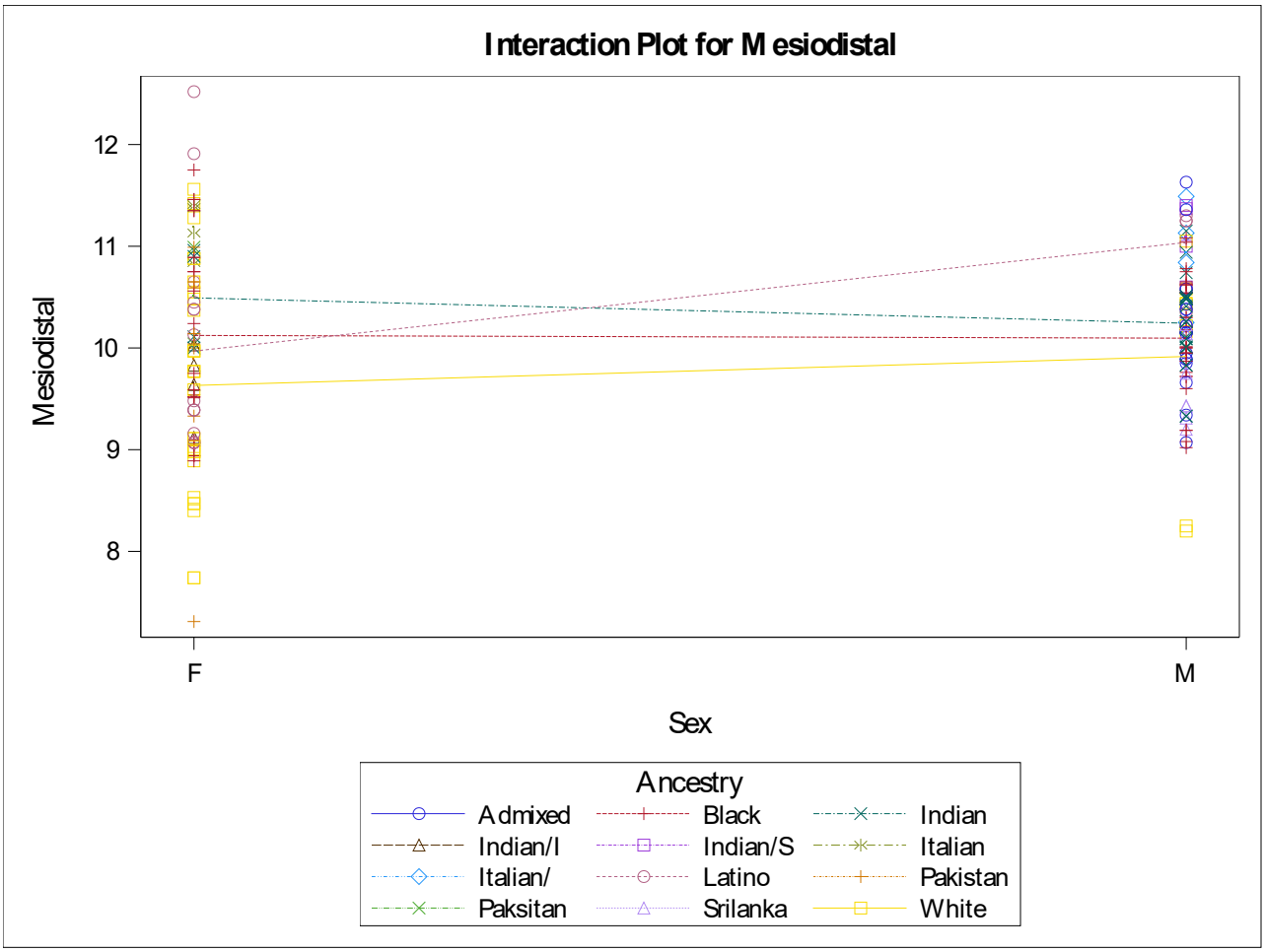
R-Square	Coeff Var	Root MSE	Mesiodistal Mean
0.187789	7.854628	0.792955	10.09538

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Sex	1	1.37924619	1.37924619	2.19	0.1403
Ancestry	11	19.83026579	1.80275144	2.87	0.0017
Sex*Ancestry	3	3.78126104	1.26042035	2.00	0.1150

The GLM Procedure

Dependent Variable: Mesiodistal

Group3=1 M2



According to the model of the analysis procedure as is, there is much significance in the mesiodistal measurements of the second molar as the values of the probability for the given F ratio, Pr > F, after sum of squares,are of very less values. When the type 3 sum of squares is calculated and considered, the variable – sex does not show much significance with respect to this particular measurement, whereas the variable – ancestry shows prominent significance and interactions as the values are less than .05.The interaction between sex and ancestry is not significant as the probability values do not lie within .05 .

The GLM Procedure

Dependent Variable: Buccolingual

Group3=1 M2

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	15	36.9903973	2.4660265	3.24	<.0001
Error	179	136.3367545	0.7616578		
Corrected Total	194	173.3271518			

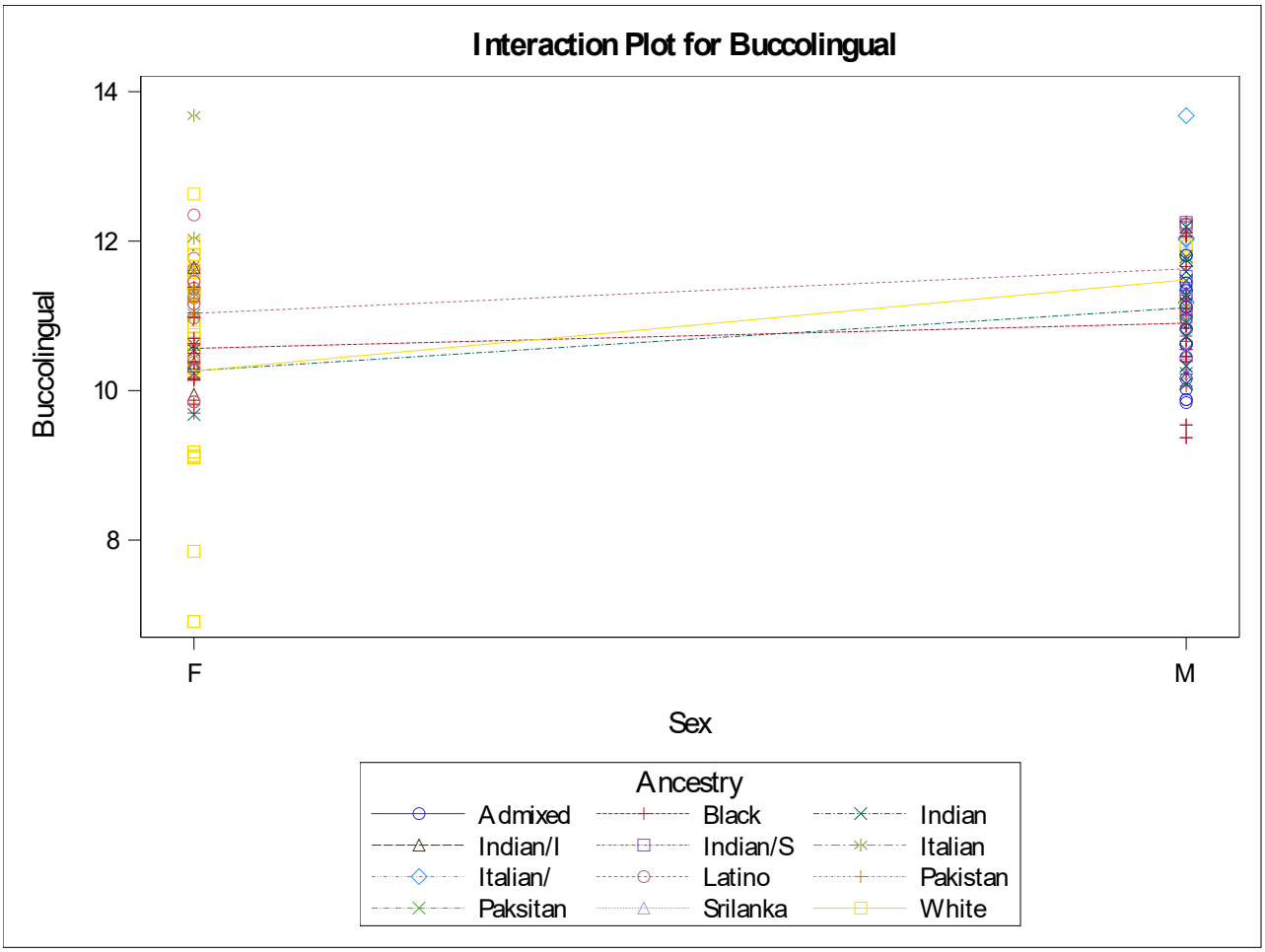
R-Square	Coeff Var	Root MSE	Buccolingual Mean
0.213414	8.027167	0.872730	10.87221

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Sex	1	10.69568134	10.69568134	14.04	0.0002
Ancestry	11	20.98794181	1.90799471	2.51	0.0059
Sex*Ancestry	3	3.49762952	1.16587651	1.53	0.2082

The GLM Procedure

Dependent Variable: Buccolingual

Group3=1 M2



According to the model of the analysis procedure as is, there is much significance in the buccolingual measurements of the second molar as the values of the probability for the given F ratio, Pr > F, after sum of squares,are of very less values. When the type 3 sum of squares is calculated and considered, the variables – sex and ancestry show prominent significance and interactions as the values are less than .05, especially the sex variable shows the influence in sexual dimorphism of the tooth.The interaction between sex and ancestry is not significant as the probability values do not lie within .05 .

The GLM Procedure

Dependent Variable: CrownHeight

Group3=1 M2

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	15	61.4674997	4.0978333	6.06	<.0001
Error	179	120.9711187	0.6758163		
Corrected Total	194	182.4386185			

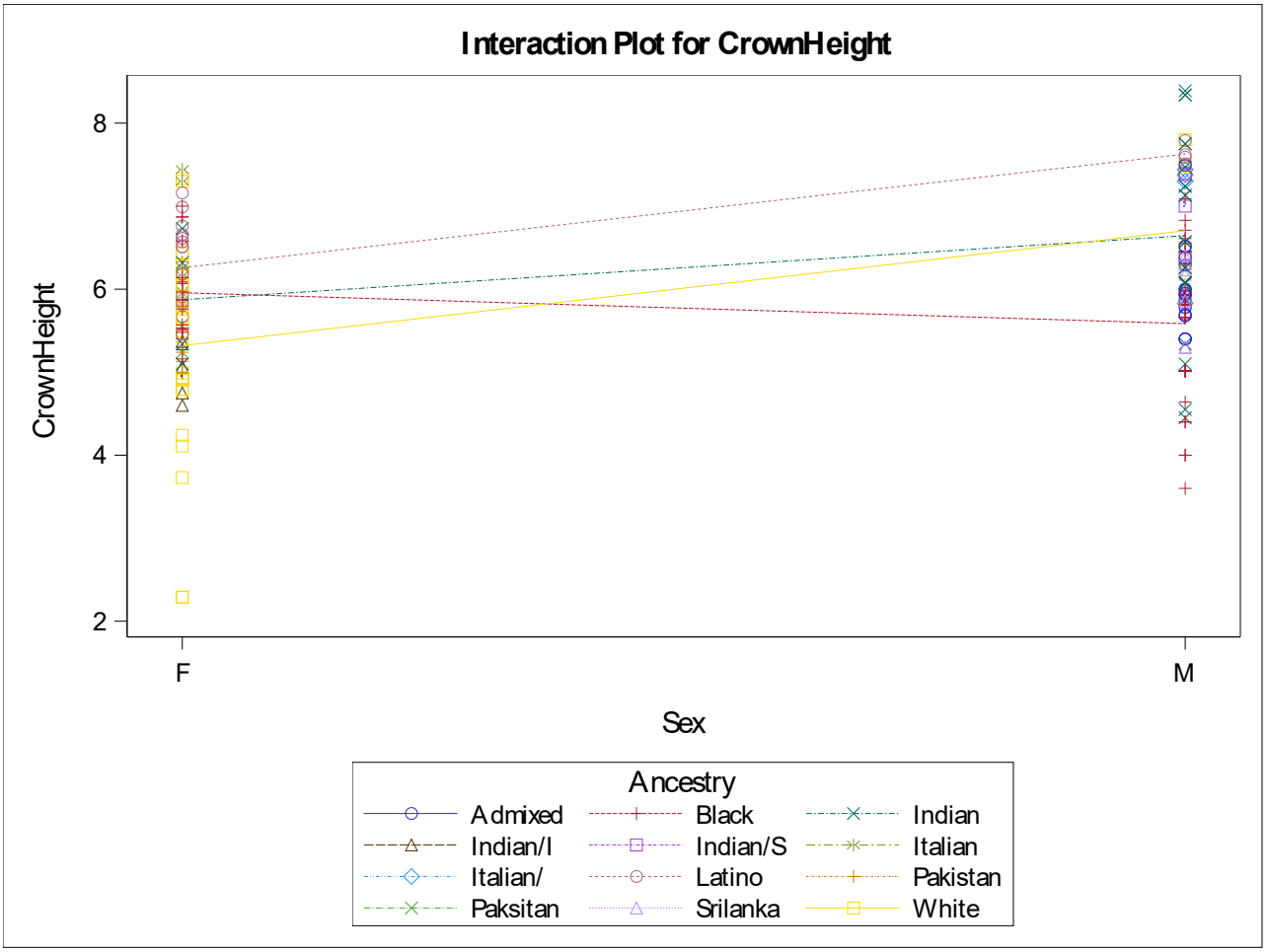
R-Square	Coeff Var	Root MSE	CrownHeight Mean
0.336922	13.74151	0.822080	5.982462

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Sex	1	11.8452339	11.84523939	17.53	<.0001
Ancestry	11	29.64985777	2.69544162	3.99	<.0001
Sex*Ancestry	3	17.74276430	5.91425477	8.75	<.0001

The GLM Procedure

Dependent Variable: CrownHeight

Group3=1 M2



According to the model of the analysis procedure as is, there is much significance in the crown height measurements of the second molar as the values of the probability for the given F ratio, Pr > F, after sum of squares,are of very less values. When the type 3 sum of squares is calculated and considered, the variable– sex and ancestry show prominent significance and interactions with respect to this particular measurement as the values are less than .05.The interaction between sex and ancestry is also prominently significant as the probability values do lie well within .05 .

The GLM Procedure

Dependent Variable: Occlusal

Group3=1 M2

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	15	28.3708966	1.8913931	3.10	0.0002
Error	179	109.1020829	0.6095088		
Corrected Total	194	137.4729795			

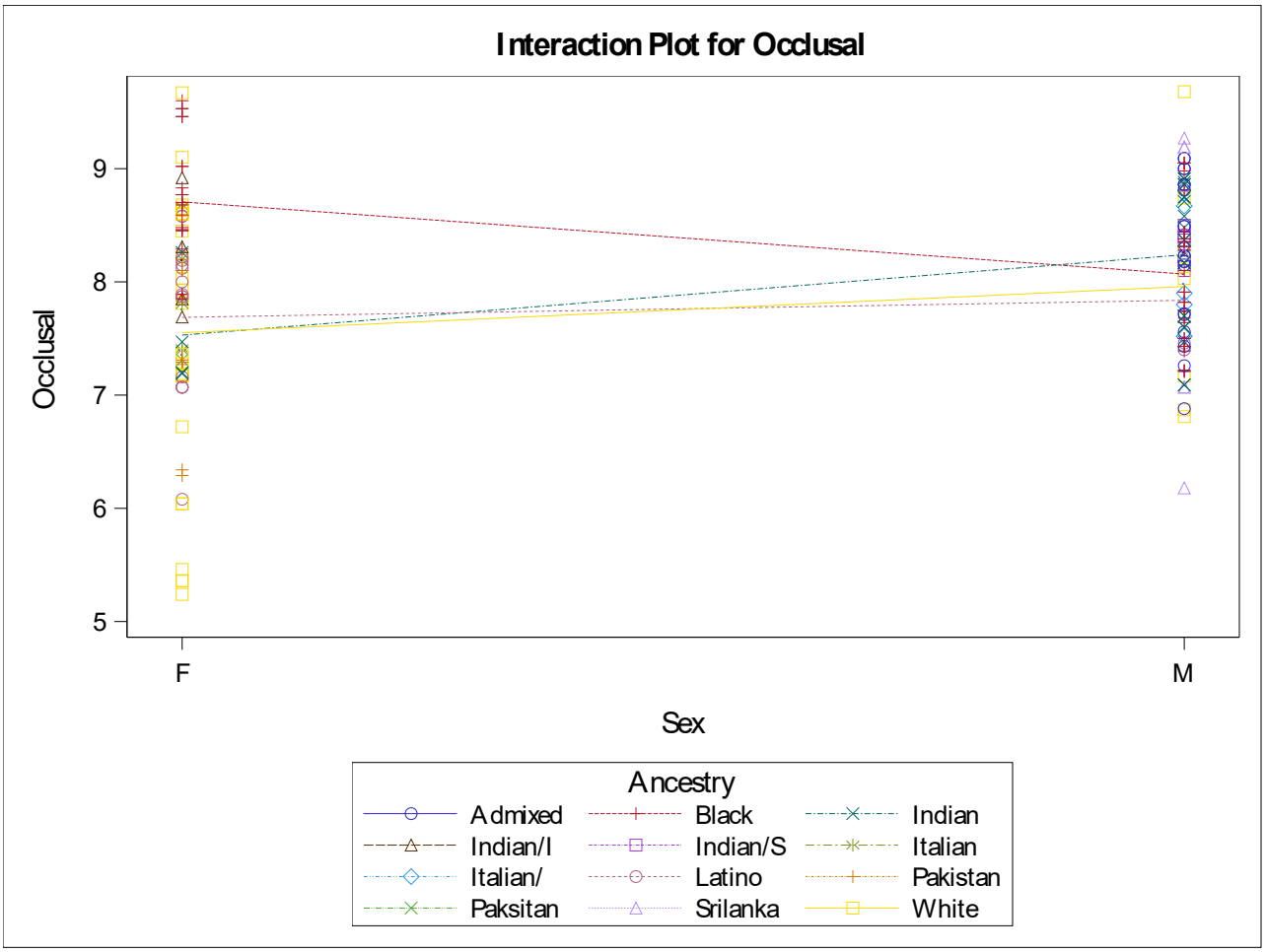
R-Square	Coeff Var	Root MSE	Occlusal Mean
0.206374	9.732989	0.780710	8.021282

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Sex	1	0.47340568	0.47340568	0.78	0.3793
Ancestry	11	13.59090397	1.23553672	2.03	0.0282
Sex*Ancestry	3	7.98594803	2.66198268	4.37	0.0054

The GLM Procedure

Dependent Variable: Occlusal

Group3=1 M2



According to the model of the analysis procedure as is, there is much significance in the occlusal measurements of the second molar as the values of the probability for the given F ratio, Pr > F, after sum of squares,are of very less values. When the type 3 sum of squares is calculated and considered, the variable – sex does not show much significance with respect to this particular measurement, whereas the variable – ancestry shows prominent significance and interactions as the values are less than .05.The interaction between sex and ancestry is significant as the probability values lie well within .05 .

The GLM Procedure

Group3=1 PM1

Class Level Information		
Class	**Levels**	**Values**
Sex	2	F M
Ancestry	11	Admixed Black Indian Indian/I Indian/S Italian Italian/ Latino Pakistan Srilankan White

Data for Analysis of Mesiodistal BuccolingualCrownHeight	
Number of Observations Read	196
Number of Observations Used	195

Data for Analysis of Occlusal	
Number of Observations Read	196
Number of Observations Used	193

Data for Analysis of Incisal	
Number of Observations Read	196
Number of Observations Used	2

Note: Variable in each group are consistent with respect to presence or absence of missing values.

The GLM Procedure

Dependent Variable: Mesiodistal

Group3=1 PM1

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	14	23.31552272	1.66539448	7.87	<.0001
Error	180	38.10194907	0.21167749		
Corrected Total	194	61.41747179			

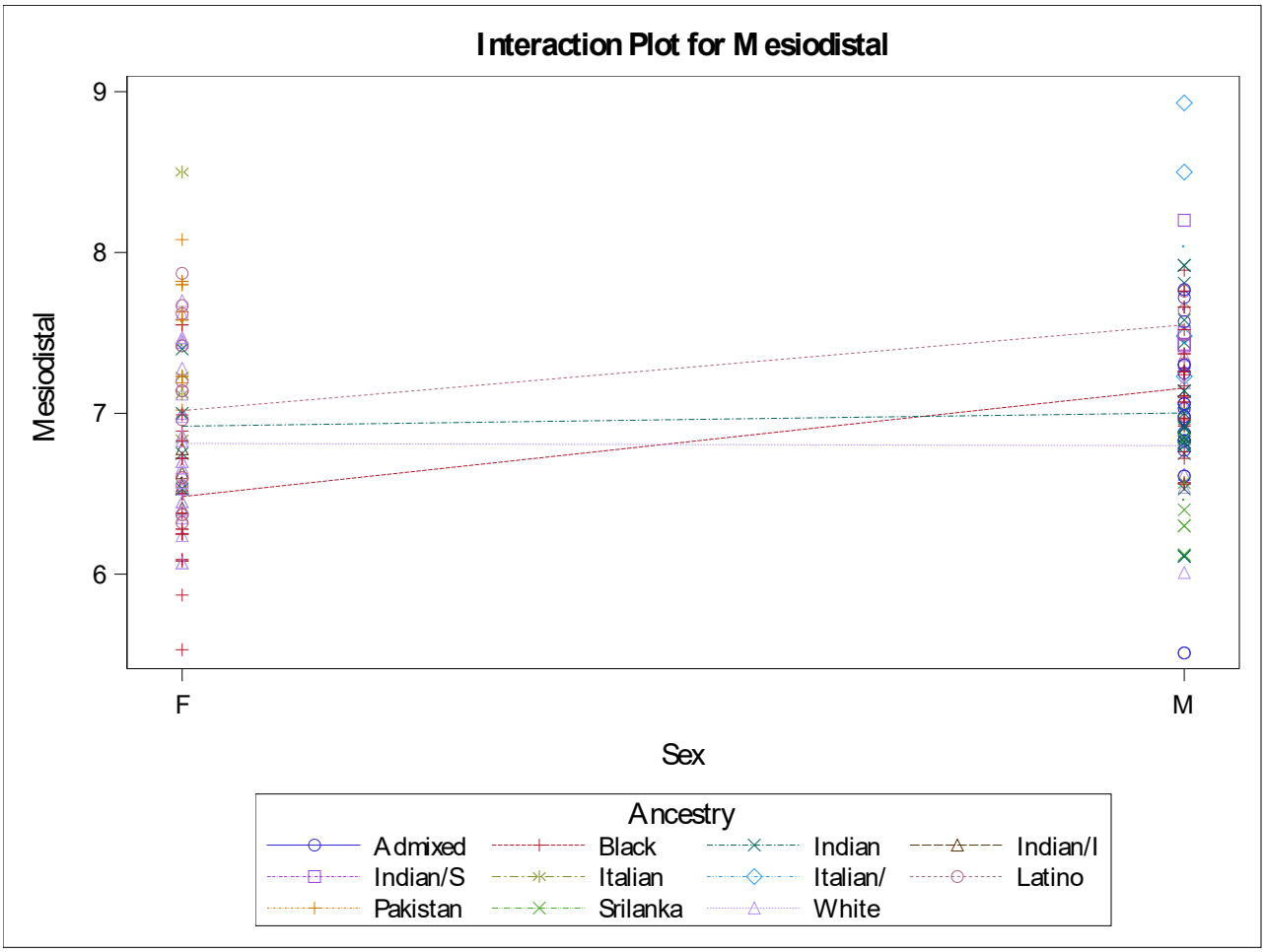
R-Square	Coeff Var	Root MSE	Mesiodistal Mean
0.379624	6.596068	0.460084	6.975128

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Sex	1	1.93295879	1.93295879	9.13	0.0029
Ancestry	10	18.72613858	1.87261386	8.85	<.0001
Sex*Ancestry	3	2.50824213	0.83608071	3.95	0.0093

The GLM Procedure

Dependent Variable: Mesiodistal

Group3=1 PM1



According to the model of the analysis procedure as is, there is much significance in the mesiodistal measurements of the first premolar as the values of the probability for the given F ratio, Pr > F, after sum of squares,are of very less values. When the type 3 sum of squares is calculated and considered, the variable– sex and ancestry show prominent significance and interactions with respect to this particular measurement as the values are less than .05.The interaction between sex and ancestry is also prominently significant as the probability values do lie well within .05.

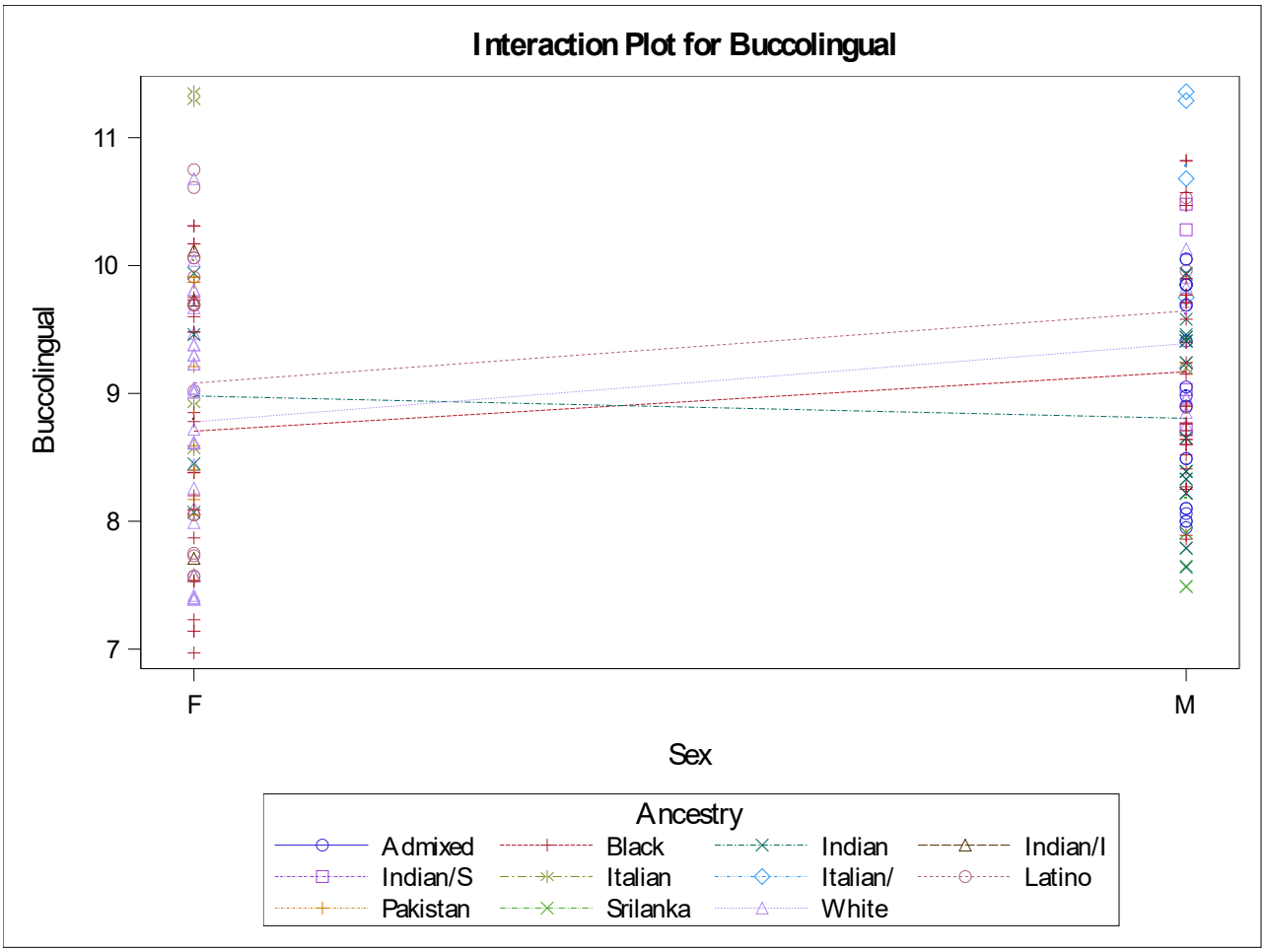
Dependent Variable: Buccolingual

Group3=1 PM1

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	14	32.5761940	2.3268710	2.77	0.0009
Error	180	151.1205875	0.8395588		
Corrected Total	194	183.6967815			

R-Square	Coeff Var	Root MSE	Buccolingual Mean
0.177337	10.18727	0.916274	8.994308

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Sex	1	2.54988552	2.54988552	3.04	0.0831
Ancestry	10	26.37162133	2.63716213	3.14	0.0010
Sex*Ancestry	3	1.52241025	0.50747008	0.60	0.6129



According to the model of the analysis procedure as is, there is much significance in the buccolingual measurements of the first premolar as the values of the probability for the given F ratio, Pr > F, after sum of squares,are of very less values. When the type 3 sum of squares is calculated and considered, the variable – sex does not show much significance with respect to this particular measurement, whereas the variable – ancestry shows prominent significance and interactions as the values are less than .05.The interaction between sex and ancestry is not significant as the probability values do not lie well within .05 .

The GLM Procedure

Dependent Variable: CrownHeight

Group3=1 PM1

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	14	47.6949367	3.4067812	5.54	<.0001
Error	180	110.7749013	0.6154161		
Corrected Total	194	158.4698379			

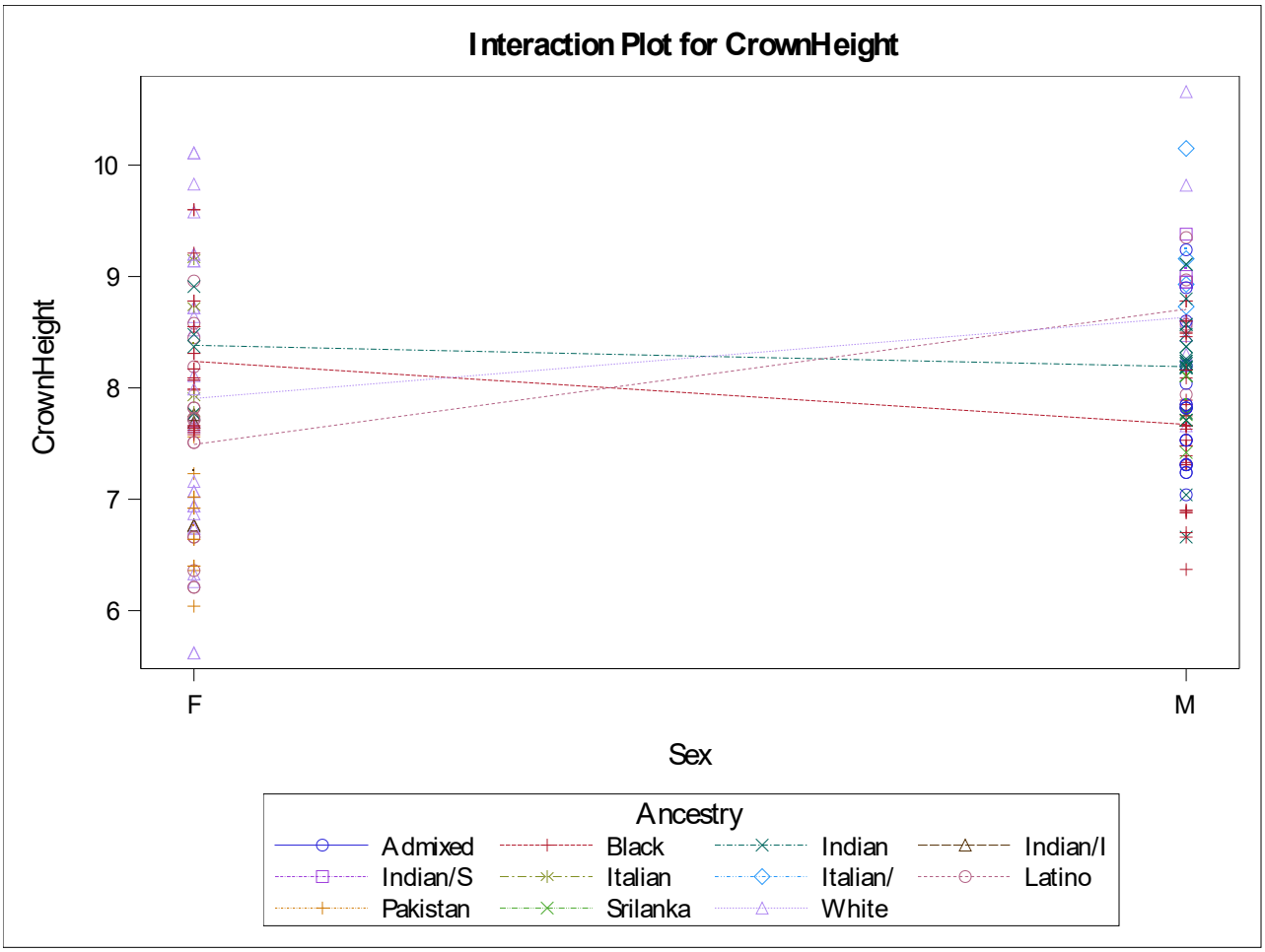
R-Square	Coeff Var	Root MSE	CrownHeight Mean
0.300972	9.895242	0.784485	7.927897

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Sex	1	1.66711178	1.66711178	2.71	0.1015
Ancestry	10	30.69061174	3.06906117	4.99	<.0001
Sex*Ancestry	3	12.54515110	4.18171703	6.79	0.0002

The GLM Procedure

Dependent Variable: CrownHeight

Group3=1 PM1



According to the model of the analysis procedure as is, there is significance in the crown height measurements of the first premolar as the values of the probability for the given F ratio, Pr > F, after sum of squares,are of less values. When the type 3 sum of squares is calculated and considered, the variable – sex does not show much significance with respect to this particular measurement, whereas the variable – ancestry shows prominent significance and interactions as the values are less than .05.The interaction between sex and ancestry is prominently significant as the probability values lie well within .05 .

The GLM Procedure

Dependent Variable: Occlusal

Group3=1 PM1

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	14	19.8053915	1.4146708	1.93	0.0256
Error	178	130.2267649	0.7316110		
Corrected Total	192	150.0321565			

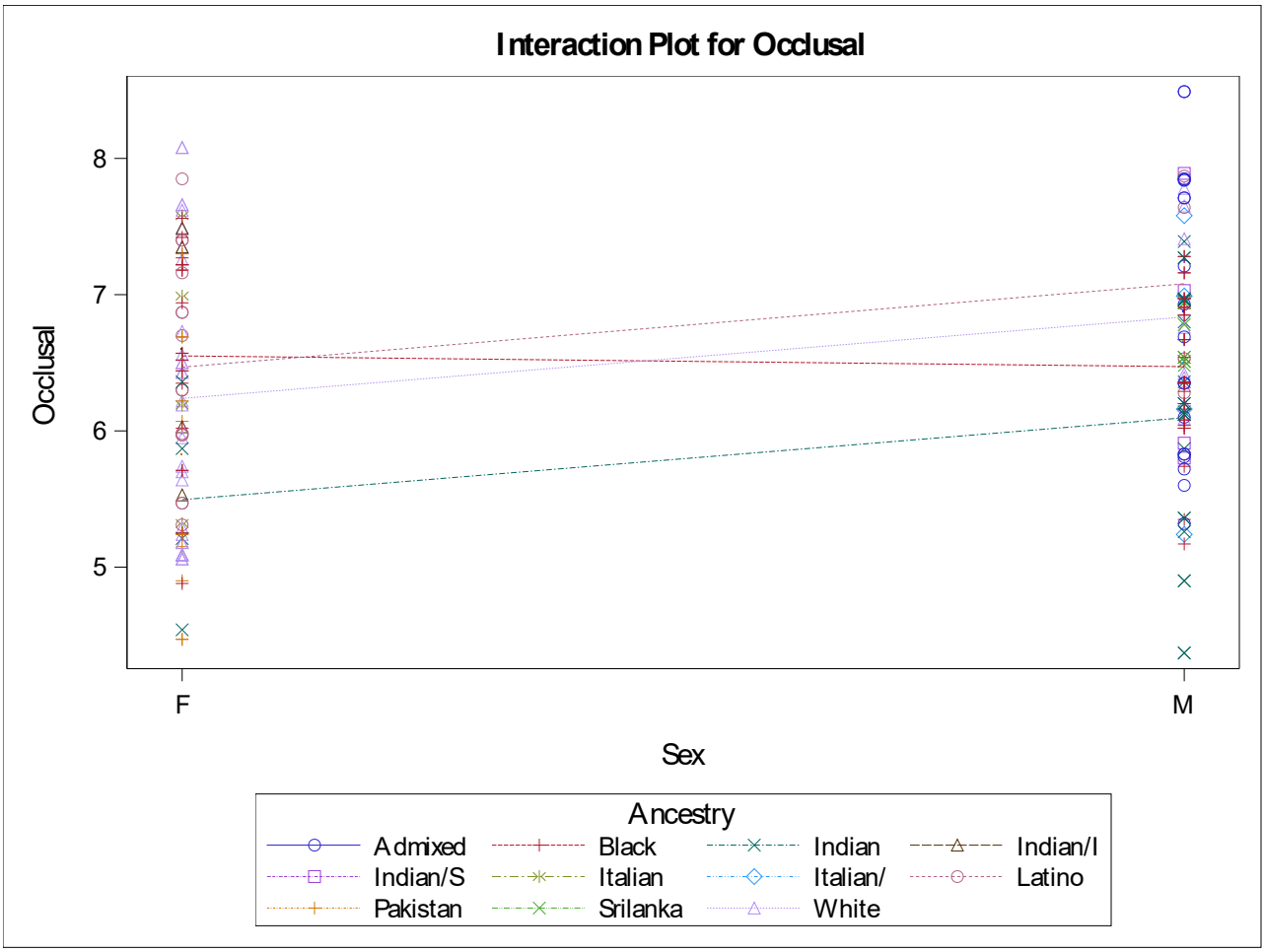
R-Square	Coeff Var	Root MSE	Occlusal Mean
0.132008	13.31149	0.855343	6.425596

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Sex	1	3.54696829	3.54696829	4.85	0.0290
Ancestry	10	13.67816828	1.36781683	1.87	0.0521
Sex*Ancestry	3	3.02245424	1.00748475	1.38	0.2513

The GLM Procedure

Dependent Variable: Occlusal

Group3=1 PM1



According to the model of the analysis procedure as is, there is much significance in the crown height measurements of the first premolar as the values of the probability for the given F ratio, Pr > F,after sum of squares,are of very less values. When the type 3 sum of squares is calculated and considered, the variables – sex and ancestry show prominent significance and interactions as the values are less than .05.The interaction between sex and ancestry is not significant as the probability values do not lie well within .05 .

The GLM Procedure

Dependent Variable: Incisal

Group3=1 PM1

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	0.08405000	0.08405000	.	.
Error	0	0.00000000	.		
Corrected Total	1	0.08405000			

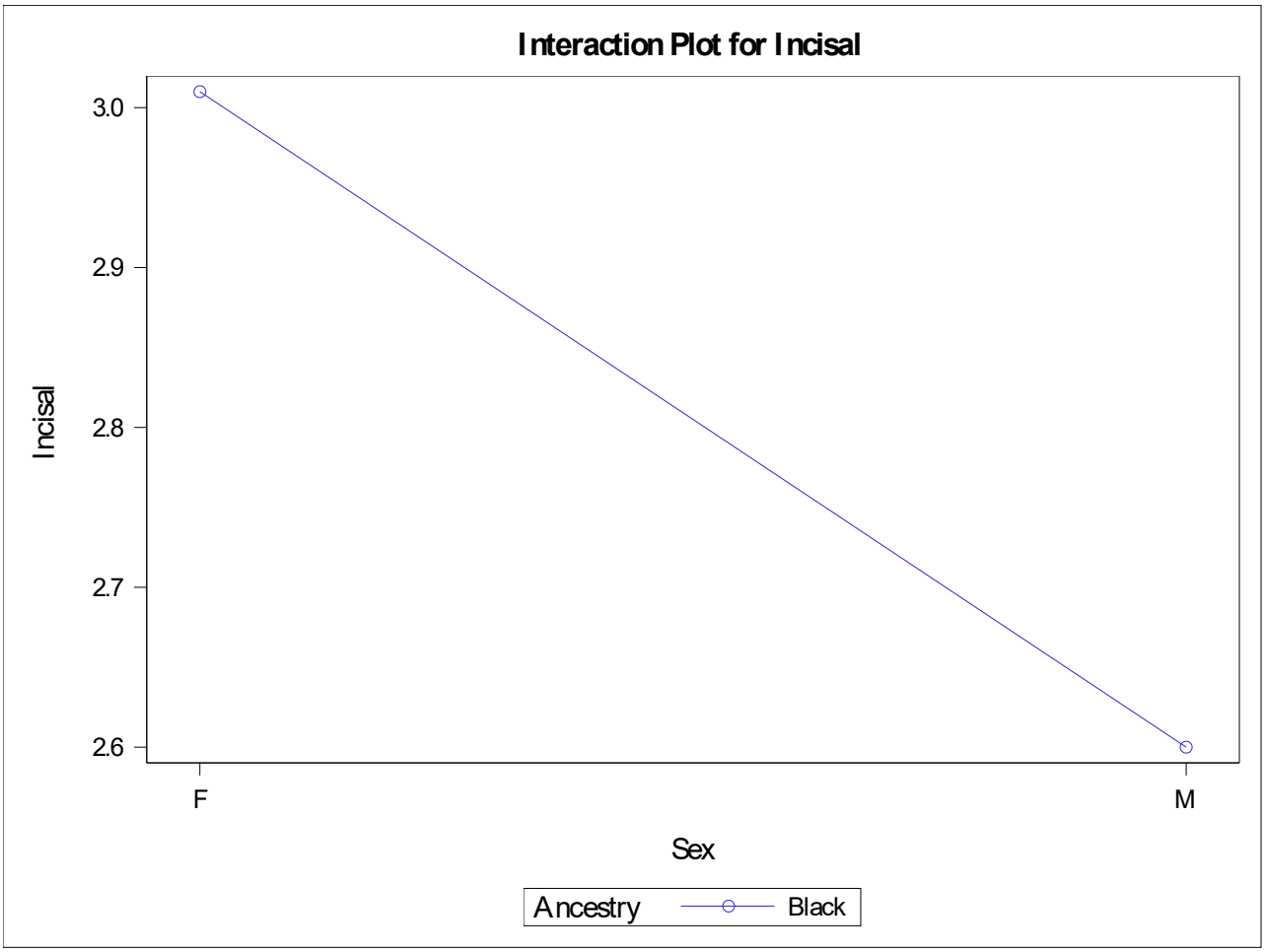
R-Square	Coeff Var	Root MSE	Incisal Mean
1.000000	.	.	2.805000

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Sex	1	0.08405000	0.08405000	.	.
Ancestry	0	0.00000000	.	.	.
Sex*Ancestry	0	0.00000000	.	.	.

The GLM Procedure

Dependent Variable: Incisal

Group3=1 PM1



Since the cutting and chewing surface of anterior teeth such as the canines, are known as incisal edges and occlusal surfaces are solely meant for those of the posterior teeth such as the premolars and molars, the first premolar does not have an incisal measurement.

The GLM Procedure

Group3=1 PM2

Class Level Information		
Class	**Levels**	**Values**
Sex	2	F M
Ancestry	11	Admixed Black Indian Indian/I Indian/S Italian Italian/ Latino Pakistan Srilankan White

Data for Analysis of Incisal	
Number of Observations Read	196
Number of Observations Used	0

Data for Analysis of Mesiodistal Buccolingual CrownHeight Occlusal	
Number of Observations Read	196
Number of Observations Used	196

Note: Variable in each group are consistent with respect to presence or absence of missing values.

The GLM Procedure

Dependent Variable: Mesiodistal

Group3=1 PM2

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	14	17.50813722	1.25058123	3.96	<.0001
Error	181	57.15392146	0.31576752		
Corrected Total	195	74.66205867			

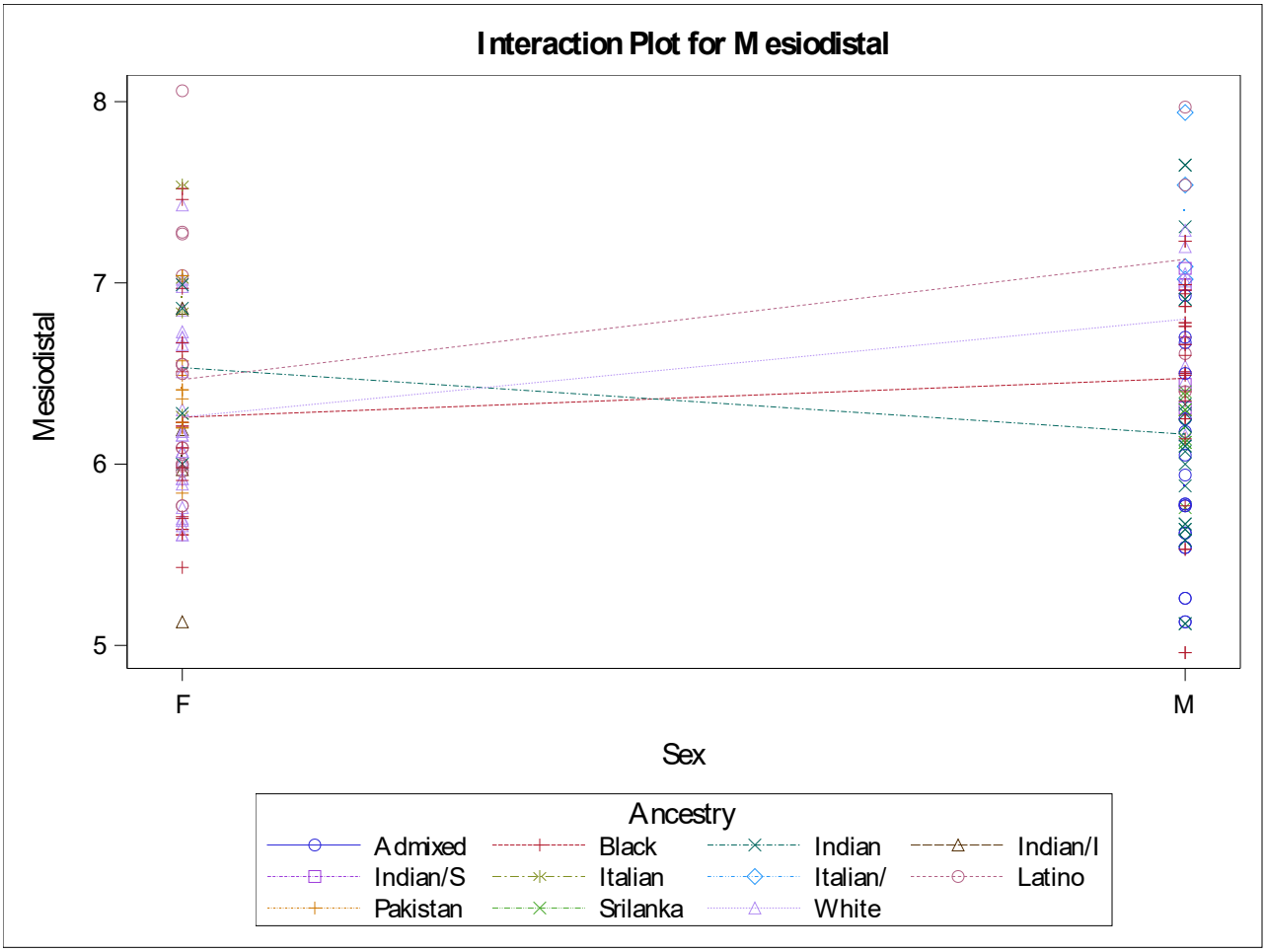
R-Square	Coeff Var	Root MSE	Mesiodistal Mean
0.234498	8.842999	0.561932	6.354541

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Sex	1	1.31536069	1.31536069	4.17	0.0427
Ancestry	10	14.63315675	1.46331567	4.63	<.0001
Sex*Ancestry	3	2.37350658	0.79116886	2.51	0.0606

The GLM Procedure

Dependent Variable: Mesiodistal

Group3=1 PM2



According to the model of the analysis procedure as is, there is much significance in the mesiodistal measurements of the second premolar as the values of the probability for the given F ratio, Pr > F, after sum of squares,are of very less values. When the type 3 sum of squares is calculated and considered, the variables – sex and ancestry show prominent significance and interactions as the values are less than .05.The interaction between sex and ancestry is not significant as the probability values do not lie well within .05 .

The GLM Procedure

Dependent Variable: Buccolingual

Group3=1 PM2

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	14	25.31324257	1.80808875	5.81	<.0001
Error	181	56.35507784	0.31135402		
Corrected Total	195	81.66832041			

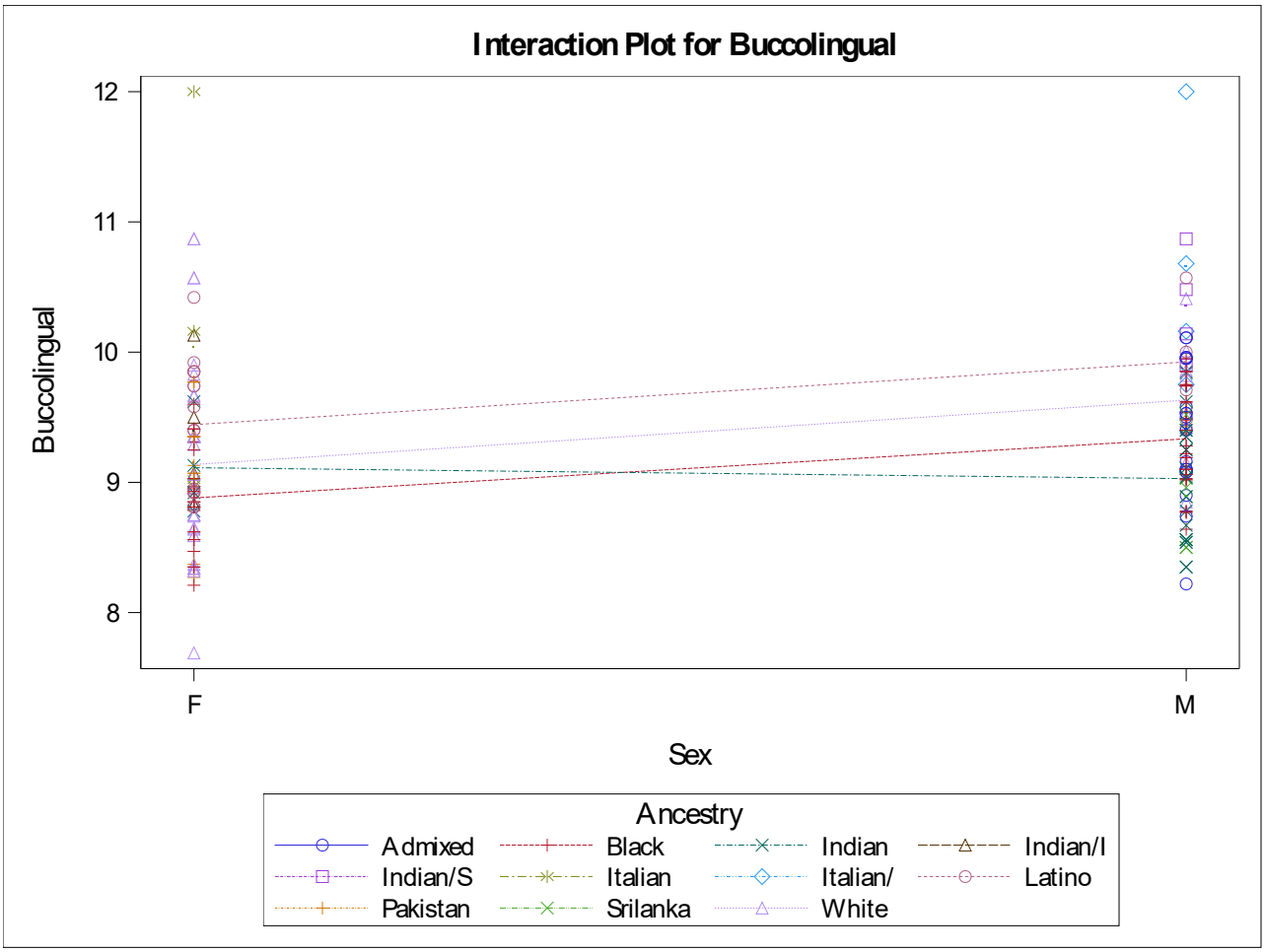
R-Square	Coeff Var	Root MSE	Buccolingual Mean
0.309952	6.011314	0.557991	9.282347

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Sex	1	2.15955393	2.15955393	6.94	0.0092
Ancestry	10	19.91748603	1.99174860	6.40	<.0001
Sex*Ancestry	3	0.90984231	0.30328077	0.97	0.4062

The GLM Procedure

Dependent Variable: Buccolingual

Group3=1 PM2



According to the model of the analysis procedure as is, there is much significance in the buccolingual measurements of the second premolar as the values of the probability for the given F ratio, Pr > F, after sum of squares,are of very less values. When the type 3 sum of squares is calculated and considered, the variables – sex and ancestry show prominent significance and interactions as the values are less than .05.The interaction between sex and ancestry is not significant as the probability values do not lie well within .05 .

The GLM Procedure

Dependent Variable: CrownHeight

Group3=1 PM2

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	14	51.1270805	3.6519343	7.69	<.0001
Error	181	85.9919292	0.4750935		
Corrected Total	195	137.1190097			

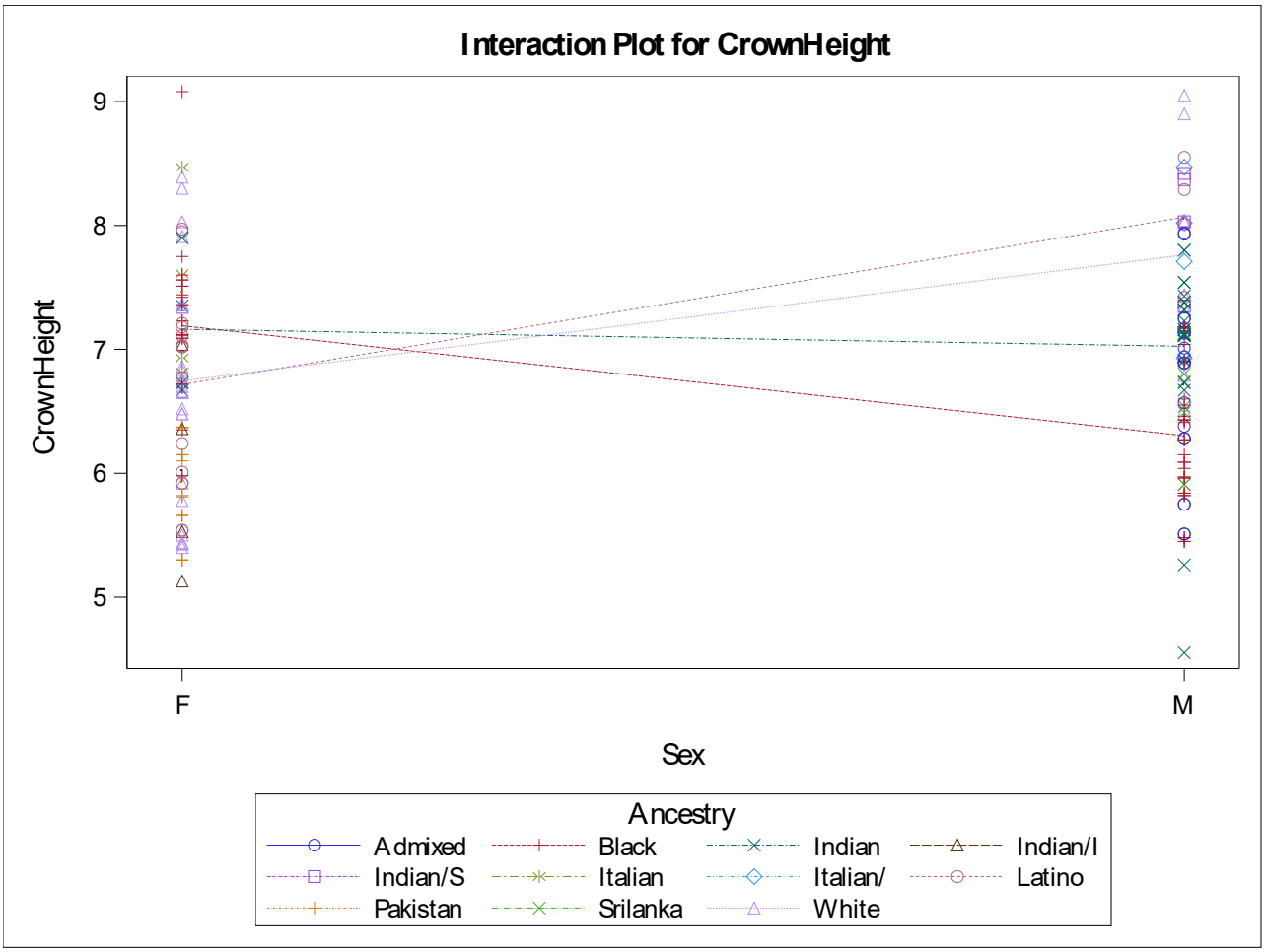
R-Square	Coeff Var	Root MSE	CrownHeight Mean
0.372866	10.10426	0.689270	6.821582

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Sex	1	2.15083708	2.15083708	4.53	0.0347
Ancestry	10	31.09860683	3.10986068	6.55	<.0001
Sex*Ancestry	3	23.09550321	7.69850107	16.20	<.0001

The GLM Procedure

Dependent Variable: CrownHeight

Group3=1 PM2



According to the model of the analysis procedure as is, there is much significance in the mesiodistal measurements of the second premolar as the values of the probability for the given F ratio, Pr > F, after sum of squares,are of very less values. When the type 3 sum of squares is calculated and considered, the variables – sex and ancestry show prominent significance and interactions as the values are less than .05.The interaction between sex and ancestry is prominently significant as the probability values lie well within .05 .

The GLM Procedure

Dependent Variable: Occlusal

Group3=1 PM2

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	14	23.9068134	1.7076295	3.30	0.0001
Error	181	93.6022616	0.5171396		
Corrected Total	195	117.5090750			

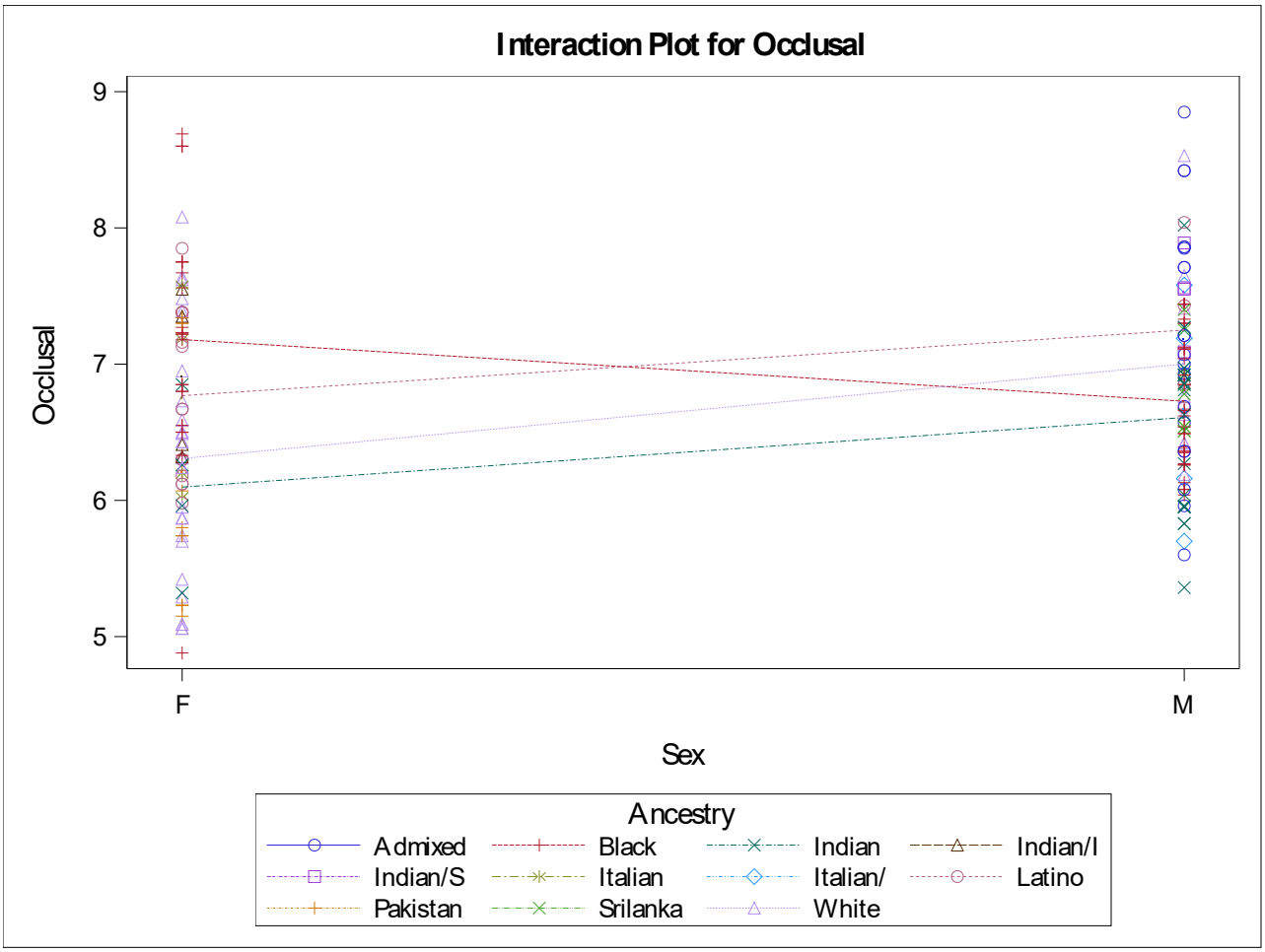
R-Square	Coeff Var	Root MSE	Occlusal Mean
0.203447	10.64637	0.719124	6.754643

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Sex	1	1.81230137	1.81230137	3.50	0.0628
Ancestry	10	11.38912811	1.13891281	2.20	0.0195
Sex*Ancestry	3	7.39603879	2.46534626	4.77	0.0032

The GLM Procedure

Dependent Variable: Occlusal

Group3=1 PM2



According to the model of the analysis procedure as is, there is significance in the occlusal measurements of the second premolar as the values of the probability for the given F ratio, Pr > F, after sum of squares,are of less values. When the type 3 sum of squares is calculated and considered, the variable – sex does not show much significance with respect to this particular measurement, whereas the variable – ancestry shows prominent significance and interactions as the values are < .05.The interaction between sex and ancestry is prominently significant as the probability values lie well within .05 .

The GLM Procedure

Group3=2 C

Class Level Information		
Class	**Levels**	**Values**
Sex	2	F M
Ancestry	11	Admixed Black Indian Indian/I Indian/S Italian Italian/ Latino Pakistan Srilankan White

Data for Analysis of Occlusal	
Number of Observations Read	202
Number of Observations Used	0

Data for Analysis of Mesiodistal Buccolingual CrownHeight Incisal	
Number of Observations Read	202
Number of Observations Used	74

Note: Variable in each group are consistent with respect to presence or absence of missing values.

The GLM Procedure

Dependent Variable: Mesiodistal

Group3=2 C

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	9	13.28574572	1.47619397	2.09	0.0434
Error	64	45.22270833	0.70660482		
Corrected Total	73	58.50845405			

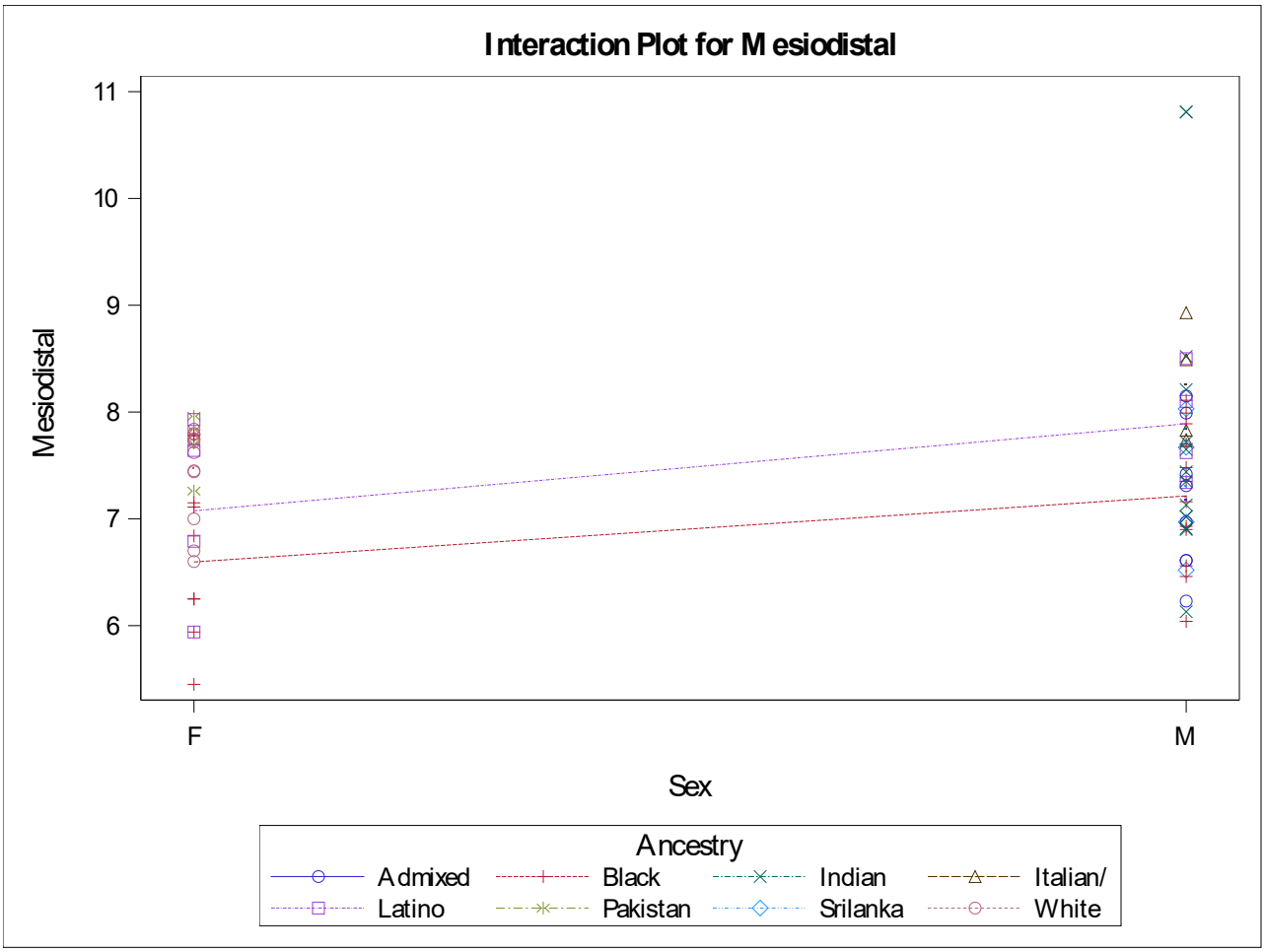
R-Square	Coeff Var	Root MSE	Mesiodistal Mean
0.227074	11.34079	0.840598	7.412162

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Sex	1	2.89870613	2.89870613	4.10	0.0470
Ancestry	7	10.98811371	1.56973053	2.22	0.0438
Sex*Ancestry	1	0.05483554	0.05483554	0.08	0.7815

The GLM Procedure

Dependent Variable: Mesiodistal

Group3=2 C



According to the model of the analysis procedure as is, there is much significance in the mesiodistal measurements of the canine as the values of the probability for the given F ratio, Pr > F, after sum of squares,are of very less values. When the type 3 sum of squares is calculated and considered, the variables – sex and ancestry show prominent significance and interactions as the values are less than .05.The interaction between sex and ancestry is not significant as the probability values do not lie within .05 .

The GLM Procedure

Dependent Variable: Buccolingual

Group3=2 C

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	9	16.14986010	1.79442890	2.62	0.0121
Error	64	43.85845476	0.68528836		
Corrected Total	73	60.00831486			

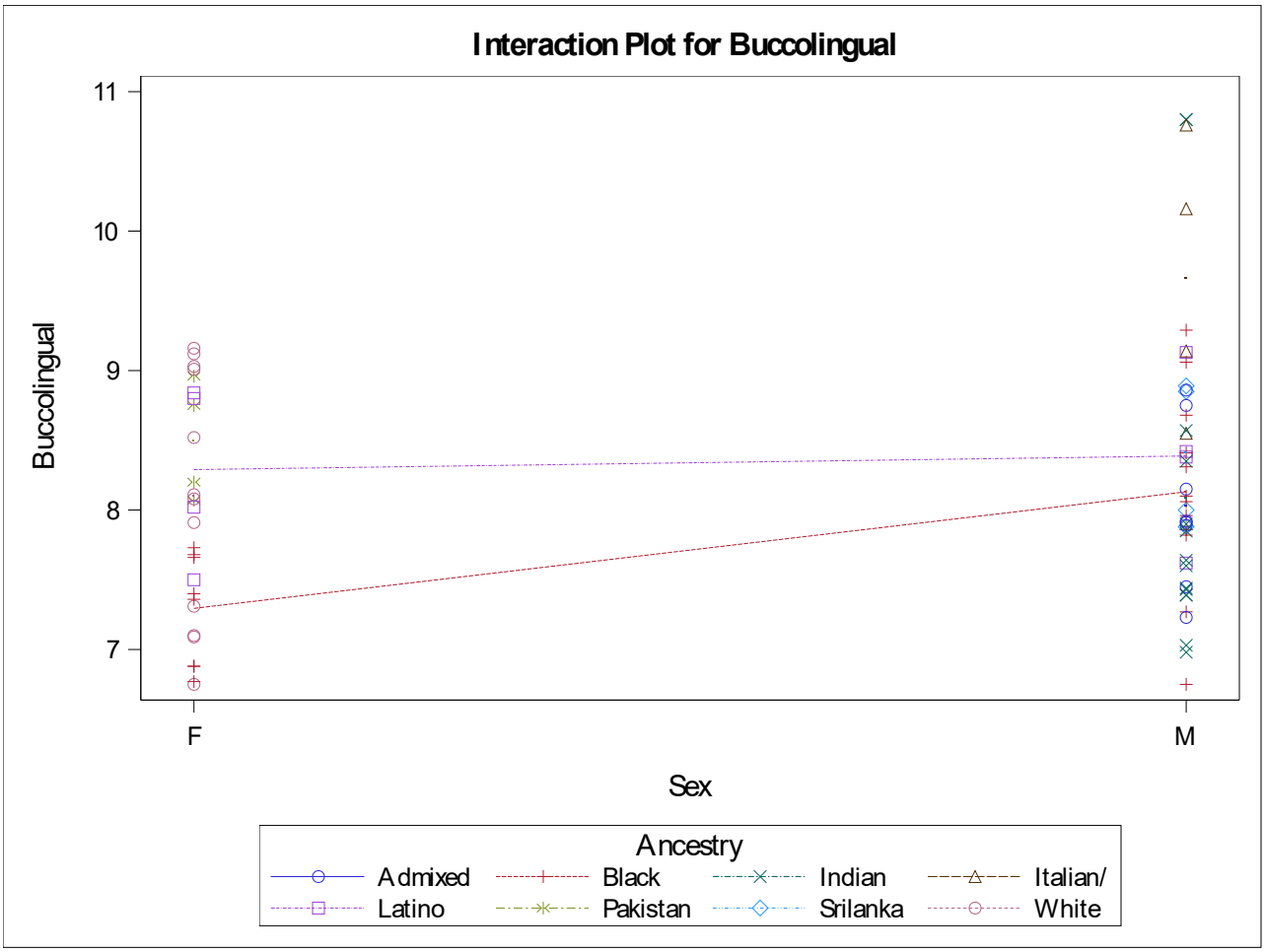
R-Square	Coeff Var	Root MSE	Buccolingual Mean
0.269127	10.15277	0.827821	8.153649

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Sex	1	1.22980392	1.22980392	1.79	0.1851
Ancestry	7	13.58736582	1.94105226	2.83	0.0123
Sex*Ancestry	1	0.76960392	0.76960392	1.12	0.2932

The GLM Procedure

Dependent Variable: Buccolingual

Group3=2 C



According to the model of the analysis procedure as is, there is much significance in the buccolingual measurements of the canine as the values of the probability for the given F ratio, Pr > F, after sum of squaresare of very less values. When the type 3 sum of squares is calculated and considered, the variable – sex does not show much significance with respect to this particular measurement, whereas the variable – ancestry shows prominent significance and interactions as the values are less than .05.The interaction between sex and ancestry is not significant as the probability values do not lie within .05 .

The GLM Procedure

Dependent Variable: CrownHeight

Group3=2 C

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	9	28.5313798	3.1701533	2.52	0.0156
Error	64	80.6364256	1.2599441		
Corrected Total	73	109.1678054			

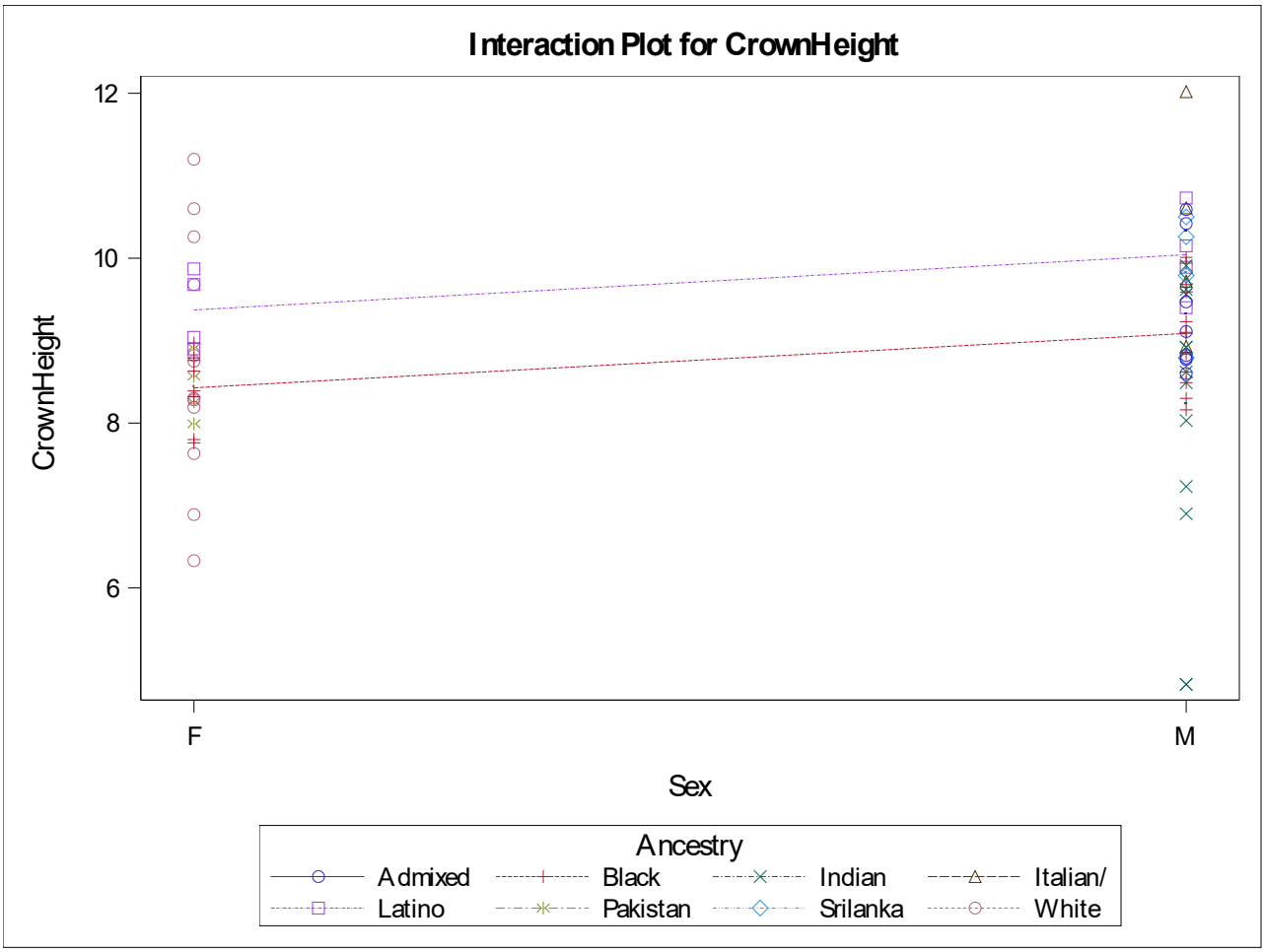
R-Square	Coeff Var	Root MSE	CrownHeight Mean
0.261353	12.52533	1.122472	8.961622

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Sex	1	2.49727059	2.49727059	1.98	0.1640
Ancestry	7	25.40831217	3.62975888	2.88	0.0111
Sex*Ancestry	1	0.00014118	0.00014118	0.00	0.9916

The GLM Procedure

Dependent Variable: CrownHeight

Group3=2 C



According to the model of the analysis procedure as is, there is much significance in the crown height measurements of the canine as the values of the probability for the given F ratio, Pr > F, after sum of squares,are of very less values. When the type 3 sum of squares is calculated and considered, the variable – sex does not show much significance with respect to this particular measurement, whereas the variable – ancestry shows prominent significance and interactions as the values are less than .05.The interaction between sex and ancestry is not significant as the probability values do not lie within .05 .

The GLM Procedure

Dependent Variable: Incisal

Group3=2 C

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	9	5.98895428	0.66543936	4.15	0.0003
Error	64	10.27404167	0.16053190		
Corrected Total	73	16.26299595			

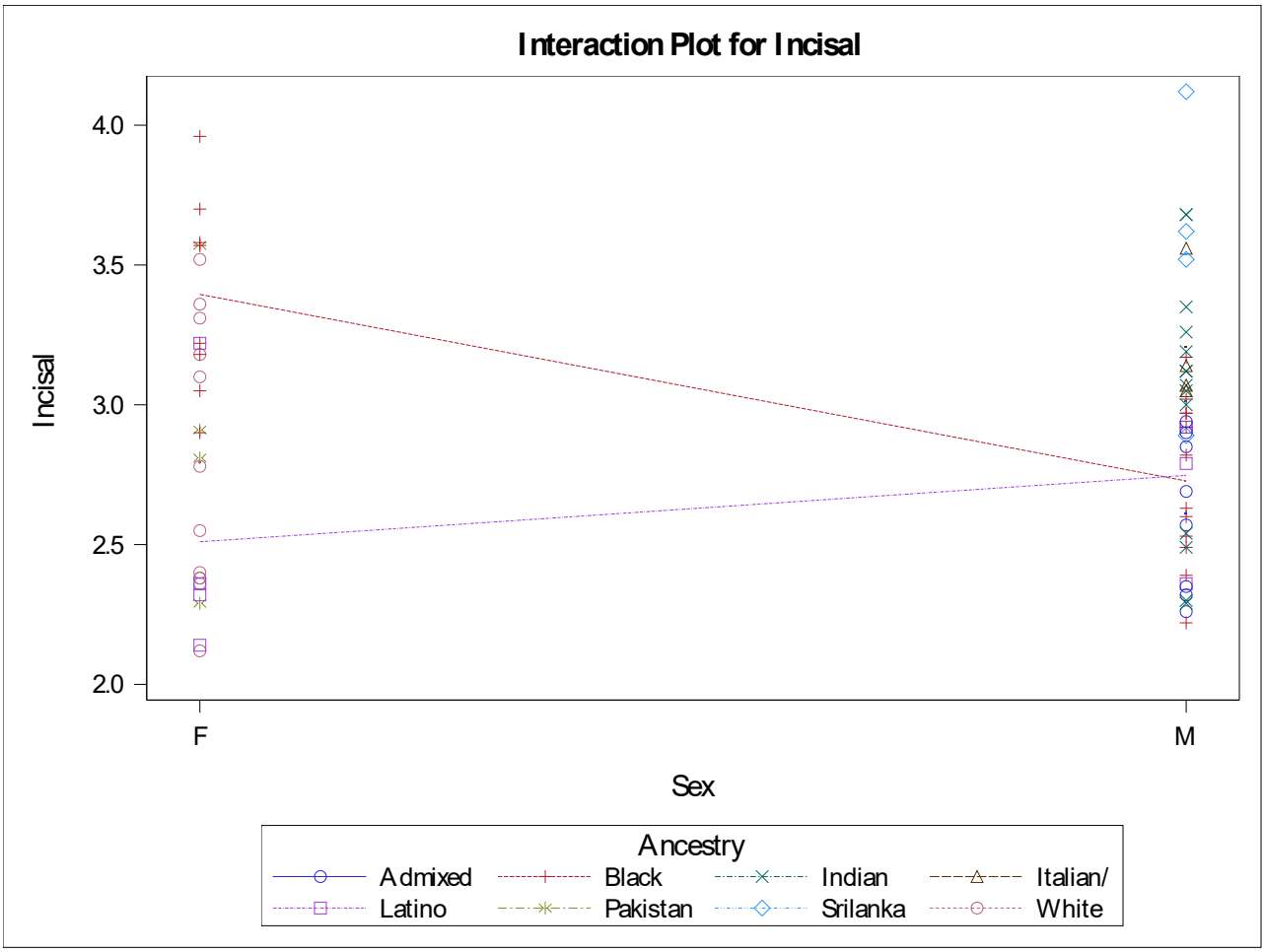
R-Square	Coeff Var	Root MSE	Incisal Mean
0.368257	13.73091	0.400664	2.917973

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Sex	1	0.26103529	0.26103529	1.63	0.2069
Ancestry	7	4.15132856	0.59304694	3.69	0.0021
Sex*Ancestry	1	1.15627059	1.15627059	7.20	0.0093

The GLM Procedure

Dependent Variable: Incisal

Group3=2 C



According to the model of the analysis procedure as is, there is much significance in the crown height measurements of the canine as the values of the probability for the given F ratio, Pr > F, after sum of squares,are of very less values. When the type 3 sum of squares is calculated and considered, the variable – sex does not show much significance with respect to this particular measurement, whereas the variable – ancestry shows prominent significance and interactions as the values are less than .05.The interaction between sex and ancestry is significant as the probability values lie within .05 .

The GLM Procedure

Group3=2 M1

Class Level Information		
Class	**Levels**	**Values**
Sex	2	F M
Ancestry	11	Admixed Black Indian Indian/I Indian/S Italian Italian/ Latino Pakistan Srilankan White

Data for Analysis of Incisal	
Number of Observations Read	202
Number of Observations Used	0

Data for Analysis of Mesiodistal Buccolingual CrownHeight Occlusal	
Number of Observations Read	202
Number of Observations Used	74

Note: Variable in each group are consistent with respect to presence or absence of missing values.

The GLM Procedure

Dependent Variable: Mesiodistal

Group3=2 M1

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	9	30.0700297	3.3411144	2.57	0.0138
Error	64	83.3069649	1.3016713		
Corrected Total	73	113.3769946			

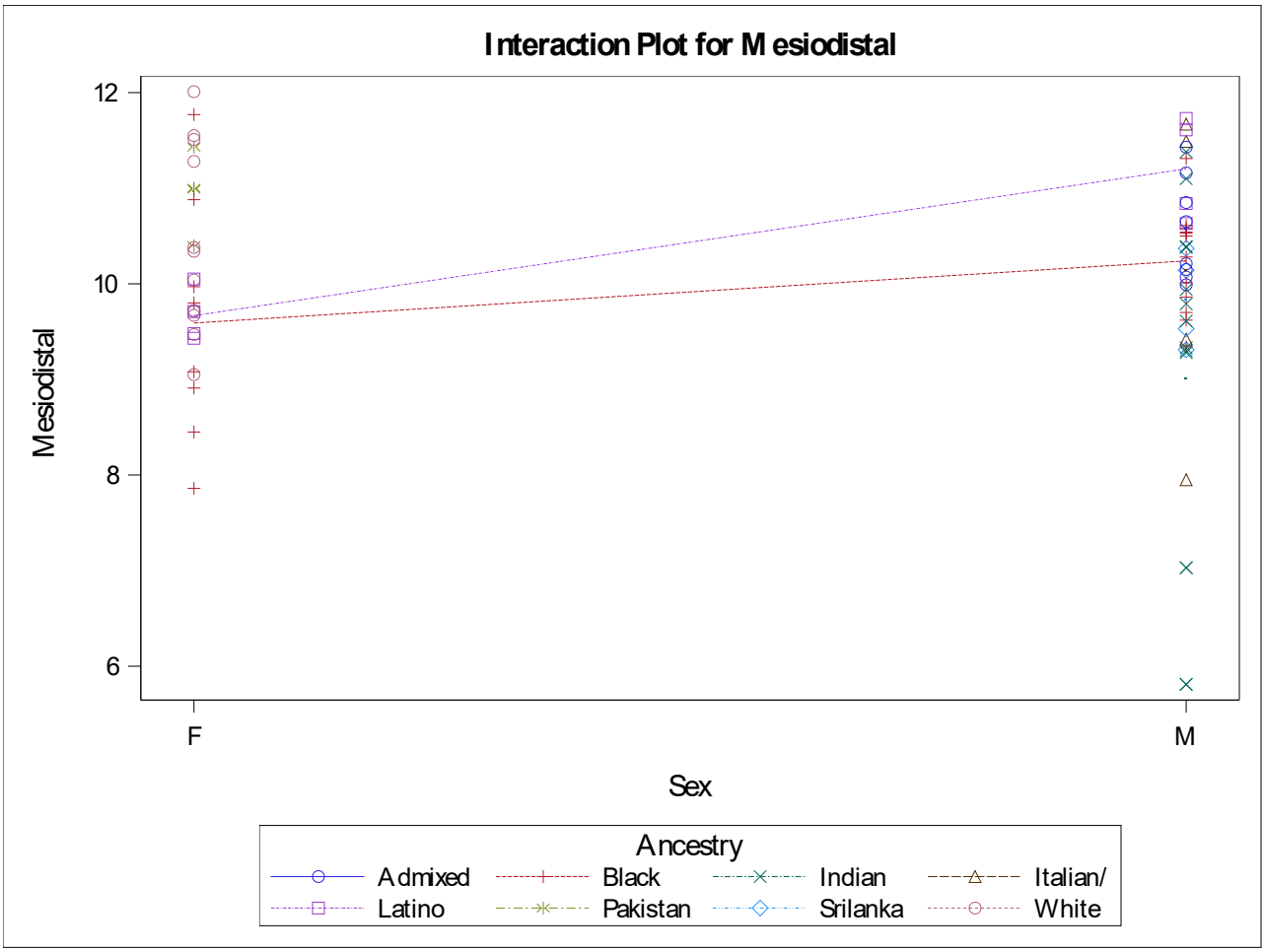
R-Square	Coeff Var	Root MSE	Mesiodistal Mean
0.265222	11.37526	1.140908	10.02973

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Sex	1	6.74008235	6.74008235	5.18	0.0262
Ancestry	7	29.48509084	4.21215583	3.24	0.0053
Sex*Ancestry	1	1.10572941	1.10572941	0.85	0.3602

The GLM Procedure

Dependent Variable: Mesiodistal

Group3=2 M1



According to the model of the analysis procedure as is, there is much significance in the mesiodistal measurements of the first molar as the values of the probability for the given F ratio, Pr > F, after sum of squares,are of very less values. When the type 3 sum of squares is calculated and considered, the variables – sex and ancestry show prominent significance and interactions as the values are less than .05.The interaction between sex and ancestry is not significant as the probability values do not lie within .05 .

The GLM Procedure

Dependent Variable: Buccolingual

Group3=2 M1

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	9	27.04015763	3.00446196	5.91	<.0001
Error	64	32.52814643	0.50825229		
Corrected Total	73	59.56830405			

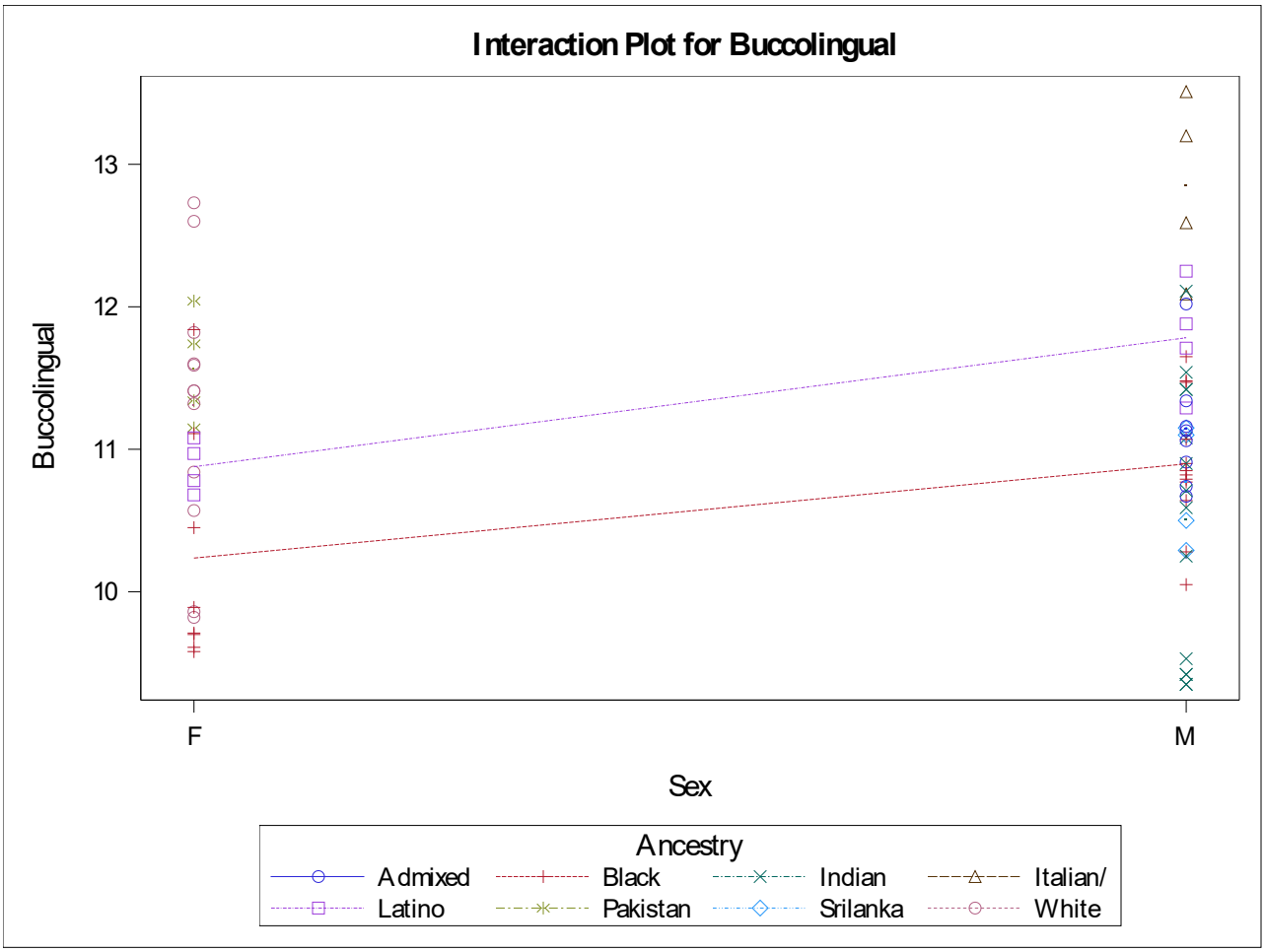
R-Square	Coeff Var	Root MSE	Buccolingual Mean
0.453935	6.467646	0.712918	11.02284

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Sex	1	3.46325515	3.46325515	6.81	0.0113
Ancestry	7	26.90742943	3.84391849	7.56	<.0001
Sex*Ancestry	1	0.08387868	0.08387868	0.17	0.6859

The GLM Procedure

Dependent Variable: Buccolingual

Group3=2 M1



According to the model of the analysis procedure as is, there is much significance in the buccolingual measurements of the first molar as the values of the probability for the given F ratio, Pr > F, after sum of squares,are of very less values. When the type 3 sum of squares is calculated and considered, the variables – sex and ancestry show prominent significance and interactions as the values are less than .05, especially ancestry.The interaction between sex and ancestry is not significant as the probability values do not lie within .05 .

The GLM Procedure

Dependent Variable: CrownHeight

Group3=2 M1

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	9	21.05501971	2.33944663	4.44	0.0002
Error	64	33.75837083	0.52747454		
Corrected Total	73	54.81339054			

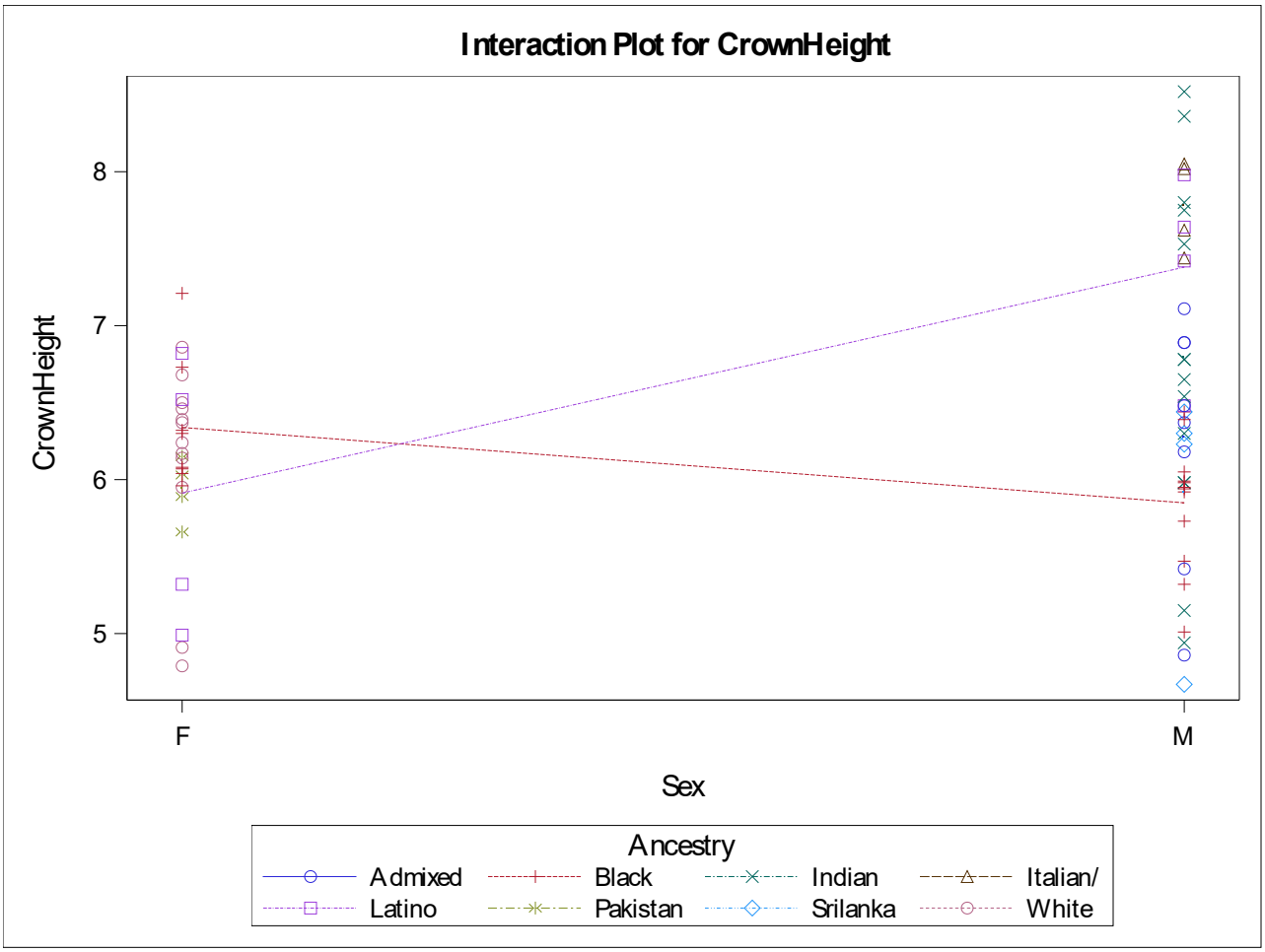
R-Square	Coeff Var	Root MSE	CrownHeight Mean
0.384122	11.40366	0.726274	6.368784

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Sex	1	1.35010025	1.35010025	2.56	0.1146
Ancestry	7	10.87703499	1.55386214	2.95	0.0097
Sex*Ancestry	1	5.40730613	5.40730613	10.25	0.0021

The GLM Procedure

Dependent Variable: CrownHeight

Group3=2 M1



According to the model of the analysis procedure as is, there is much significance in the crown height measurements of the first molar as the values of the probability for the given F ratio, Pr > F, after sum of squares,are of very less values. When the type 3 sum of squares is calculated and considered, the variable – sex does not show much significance with respect to this particular measurement, whereas the variable – ancestry shows prominent significance and interactions as the values are less than .05.The interaction between sex and ancestry is significant as the probability values lie within .05 .

The GLM Procedure

Dependent Variable: Occlusal

Group3=2 M1

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	9	8.99347564	0.99927507	1.66	0.1172
Error	64	38.50152976	0.60158640		
Corrected Total	73	47.49500541			

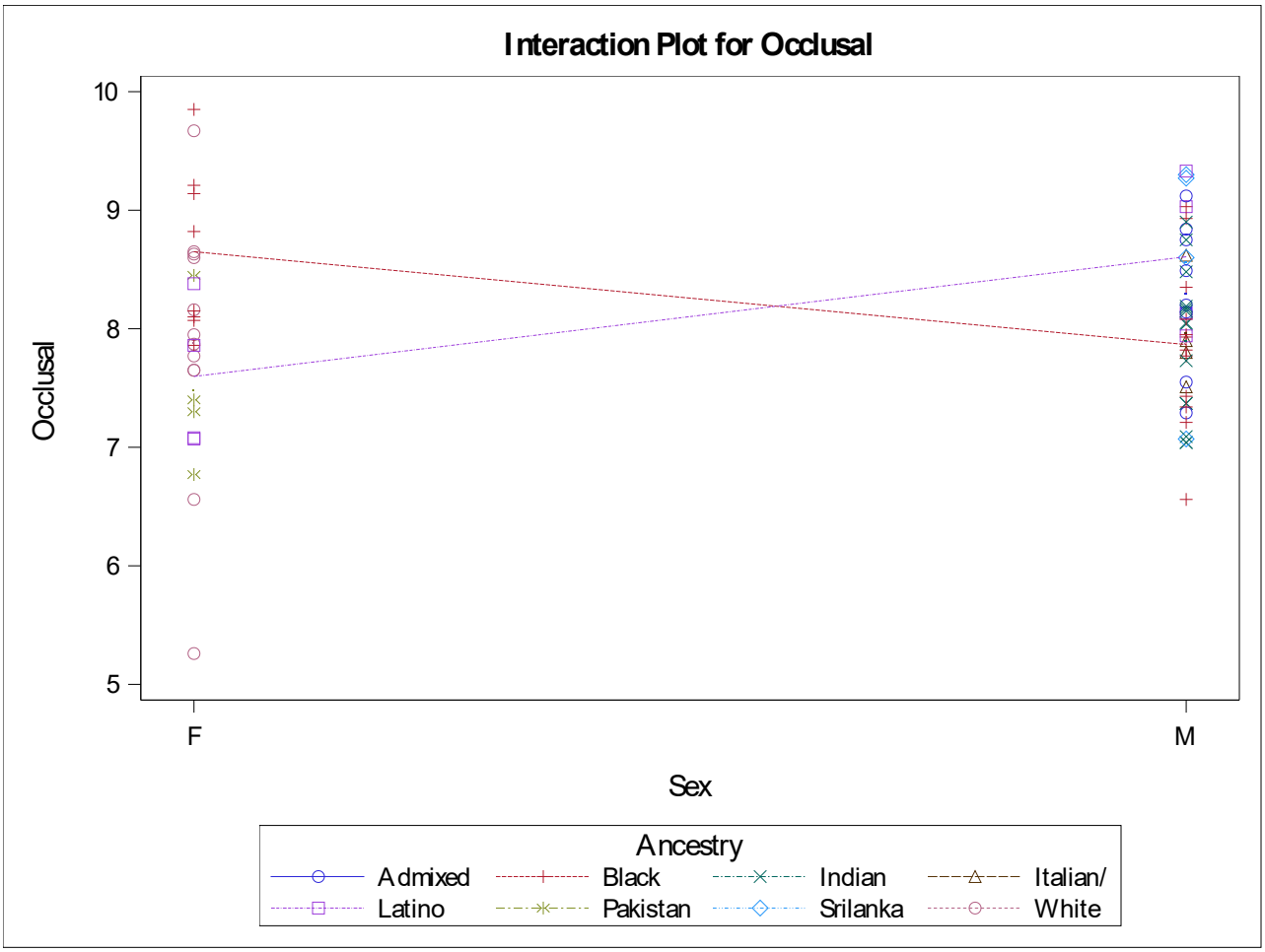
R-Square	Coeff Var	Root MSE	Occlusal Mean
0.189356	9.636973	0.775620	8.048378

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Sex	1	0.07253333	0.07253333	0.12	0.7296
Ancestry	7	3.81105094	0.54443585	0.91	0.5084
Sex*Ancestry	1	4.54029804	4.54029804	7.55	0.0078

The GLM Procedure

Dependent Variable: Occlusal

Group3=2 M1



According to the model of the analysis procedure as is, there is not much of significance in the occlusal measurements of the first molar as the values of the probability for the given F ratio, Pr > F, after sum of squares,are of very less values. When the type 3 sum of squares is calculated and considered, the variables – sex and ancestry do not show prominent significance and interactions as the values are not less than .05.The interaction between sex and ancestry is significant as the probability values lie within .05 .

The GLM Procedure

Group3=2 M2

Class Level Information		
Class	**Levels**	**Values**
Sex	2	F M
Ancestry	12	Admixed Black Indian Indian/I Indian/S Italian Italian/ Latino Pakistan Paksitan Srilankan White

Data for Analysis of Incisal	
Number of Observations Read	202
Number of Observations Used	0

Data for Analysis of Mesiodistal Buccolingual CrownHeight Occlusal	
Number of Observations Read	202
Number of Observations Used	74

Note: Variable in each group are consistent with respect to presence or absence of missing values.

The GLM Procedure

Dependent Variable: Mesiodistal

Group3=2 M2

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	10	16.64997883	1.66499788	2.25	0.0258
Error	63	46.67103333	0.74081005		
Corrected Total	73	63.32101216			

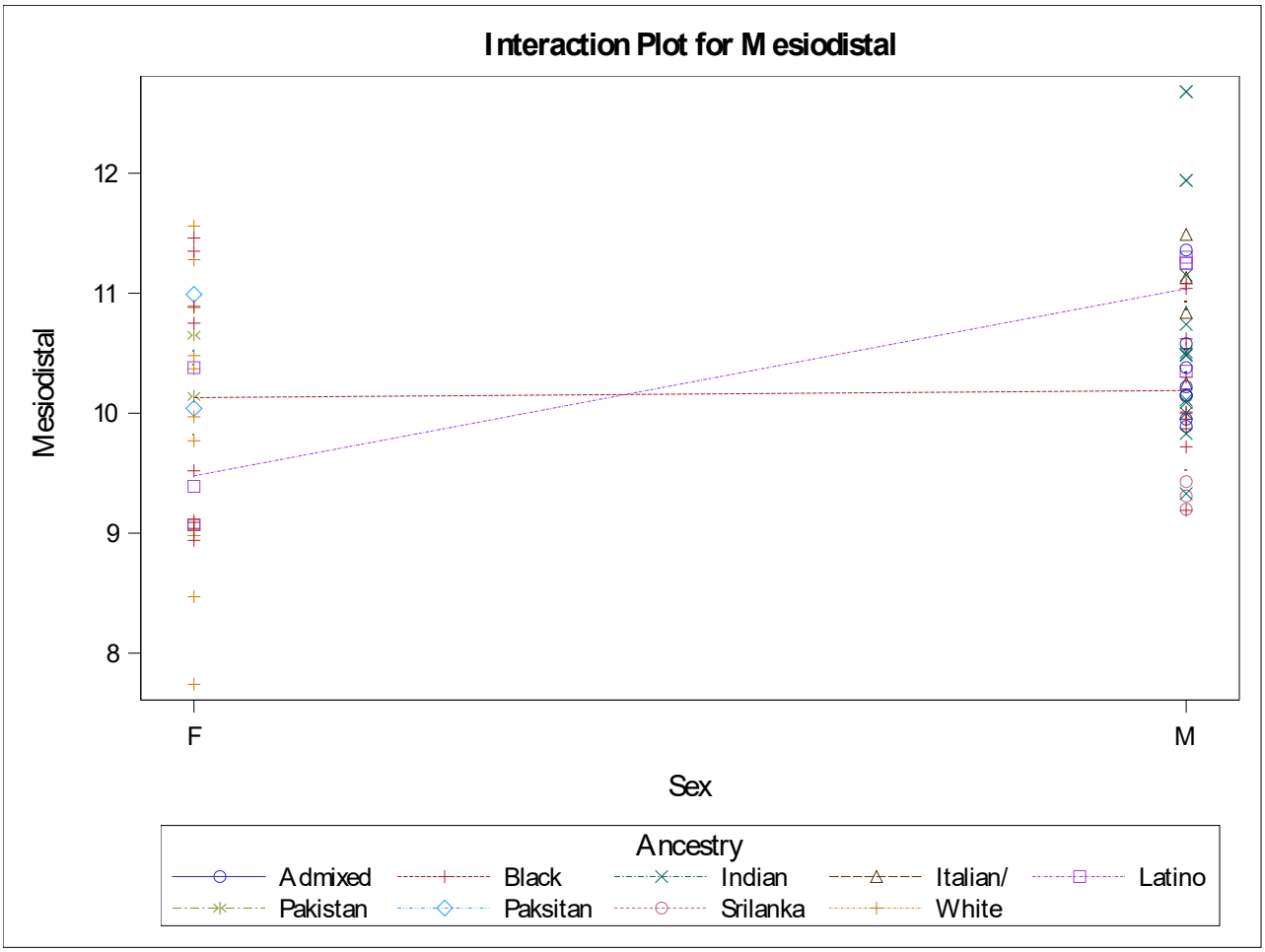
R-Square	Coeff Var	Root MSE	Mesiodistal Mean
0.262946	8.366551	0.860703	10.28743

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Sex	1	3.70122451	3.70122451	5.00	0.0290
Ancestry	8	8.05317783	1.00664723	1.36	0.2321
Sex*Ancestry	1	3.18000098	3.18000098	4.29	0.0424

The GLM Procedure

Dependent Variable: Mesiodistal

Group3=2 M2



According to the model of the analysis procedure as is, there is significance in the mesiodistal measurements of the second molar as the values of the probability for the given F ratio, Pr > F, after sum of squares,are of less values. When the type 3 sum of squares is calculated and considered, the variable – ancestry does not show much significance with respect to this particular measurement, whereas the variable – sex shows prominent significance and interactions as the values are < .05.The interaction between sex and ancestry is significant as the probability values lie within .05 .

The GLM Procedure

Dependent Variable: Buccolingual

Group3=2 M2

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	10	12.33675695	1.23367569	1.28	0.2627
Error	63	60.86347143	0.96608685		
Corrected Total	73	73.20022838			

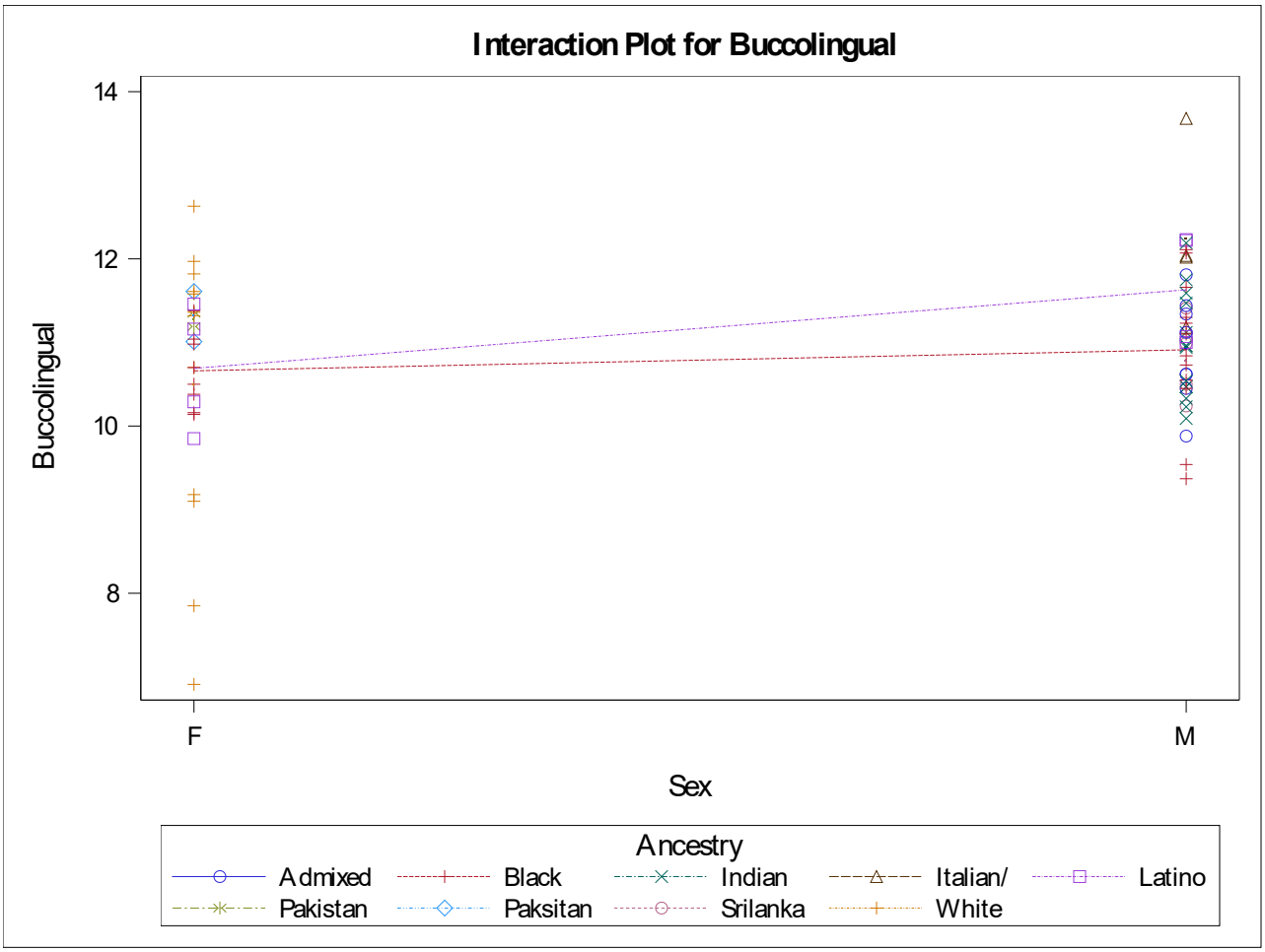
R-Square	Coeff Var	Root MSE	Buccolingual Mean
0.168534	8.988987	0.982897	10.93446

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Sex	1	2.00760882	2.00760882	2.08	0.1544
Ancestry	8	8.95160281	1.11895035	1.16	0.3384
Sex*Ancestry	1	0.66727941	0.66727941	0.69	0.4091

The GLM Procedure

Dependent Variable: Buccolingual

Group3=2 M2



According to the model of the analysis procedure as is, there is not much significance in the buccolingual measurements of the second molar as the values of the probability for the given F ratio, Pr > F, after sum of squares,are not of very less values. When the type 3 sum of squares is calculated and considered, the variables – sex and ancestry do not show prominent significance and interactions as the values are more than .05.The interaction etween sex and ancestry is not significant as the probability values do not lie within .05 .

The GLM Procedure

Dependent Variable: CrownHeight

Group3=2 M2

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	10	20.16266435	2.01626644	2.45	0.0155
Error	63	51.92832619	0.82425915		
Corrected Total	73	72.09099054			

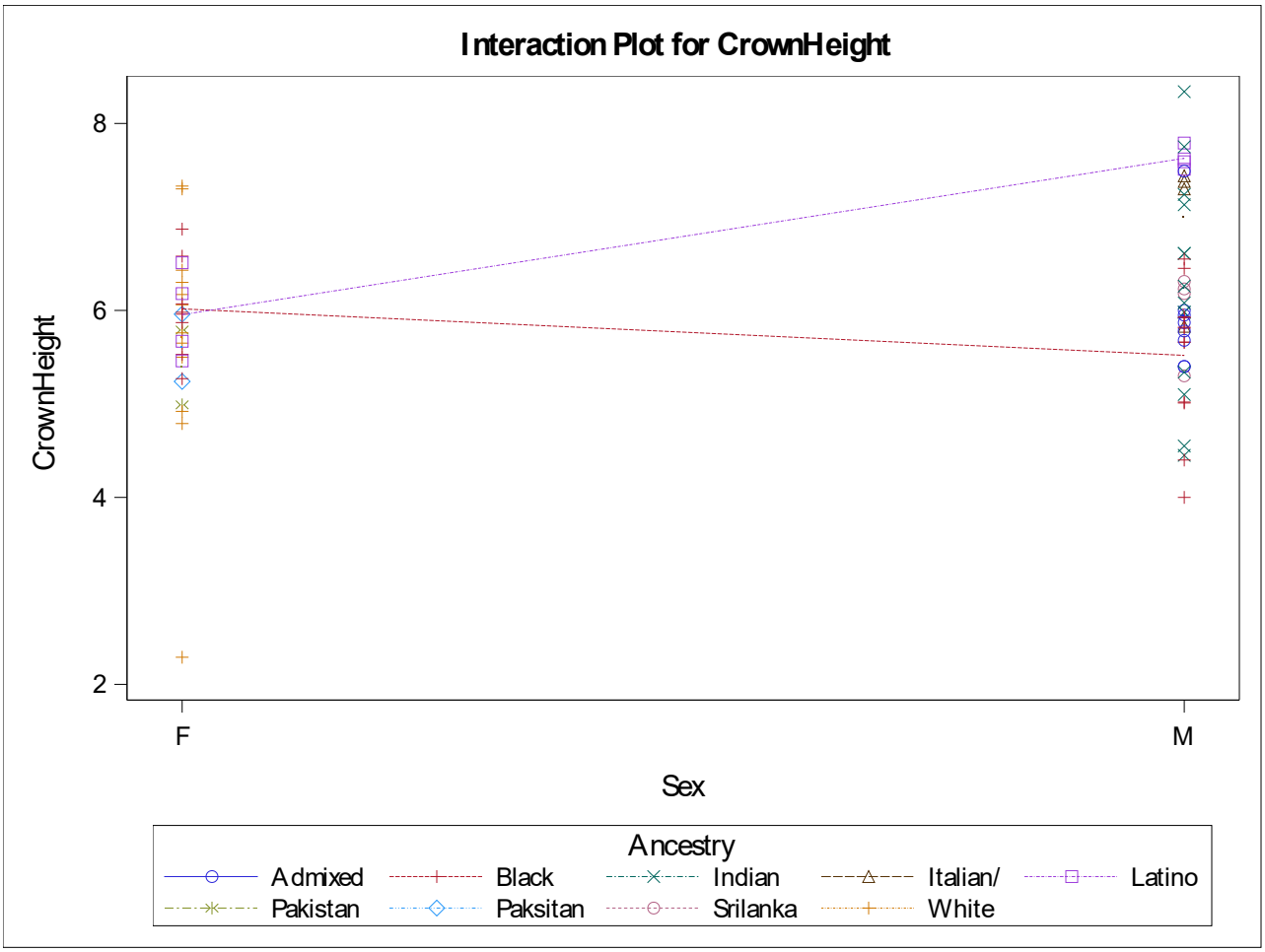
R-Square	Coeff Var	Root MSE	CrownHeight Mean
0.279684	15.05921	0.907887	6.028784

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Sex	1	1.95050025	1.95050025	2.37	0.1290
Ancestry	8	9.49969337	1.18746167	1.44	0.1975
Sex*Ancestry	1	6.64530613	6.64530613	8.06	0.0061

The GLM Procedure

Dependent Variable: CrownHeight

Group3=2 M2



According to the model of the analysis procedure as is, there is much significance in the crown height measurements of the second molar as the values of the probability for the given F ratio, Pr > F, after sum of squares,are of very less values. When the type 3 sum of squares is calculated and considered, the variables – sex and ancestry do not show prominent significance and interactions as the values are more than .05.The interaction between sex and ancestry is significant as the probability values lie within .05 .

The GLM Procedure

Dependent Variable: Occlusal

Group3=2 M2

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	10	7.02023710	0.70202371	1.03	0.4304
Error	63	42.99763452	0.68250214		
Corrected Total	73	50.01787162			

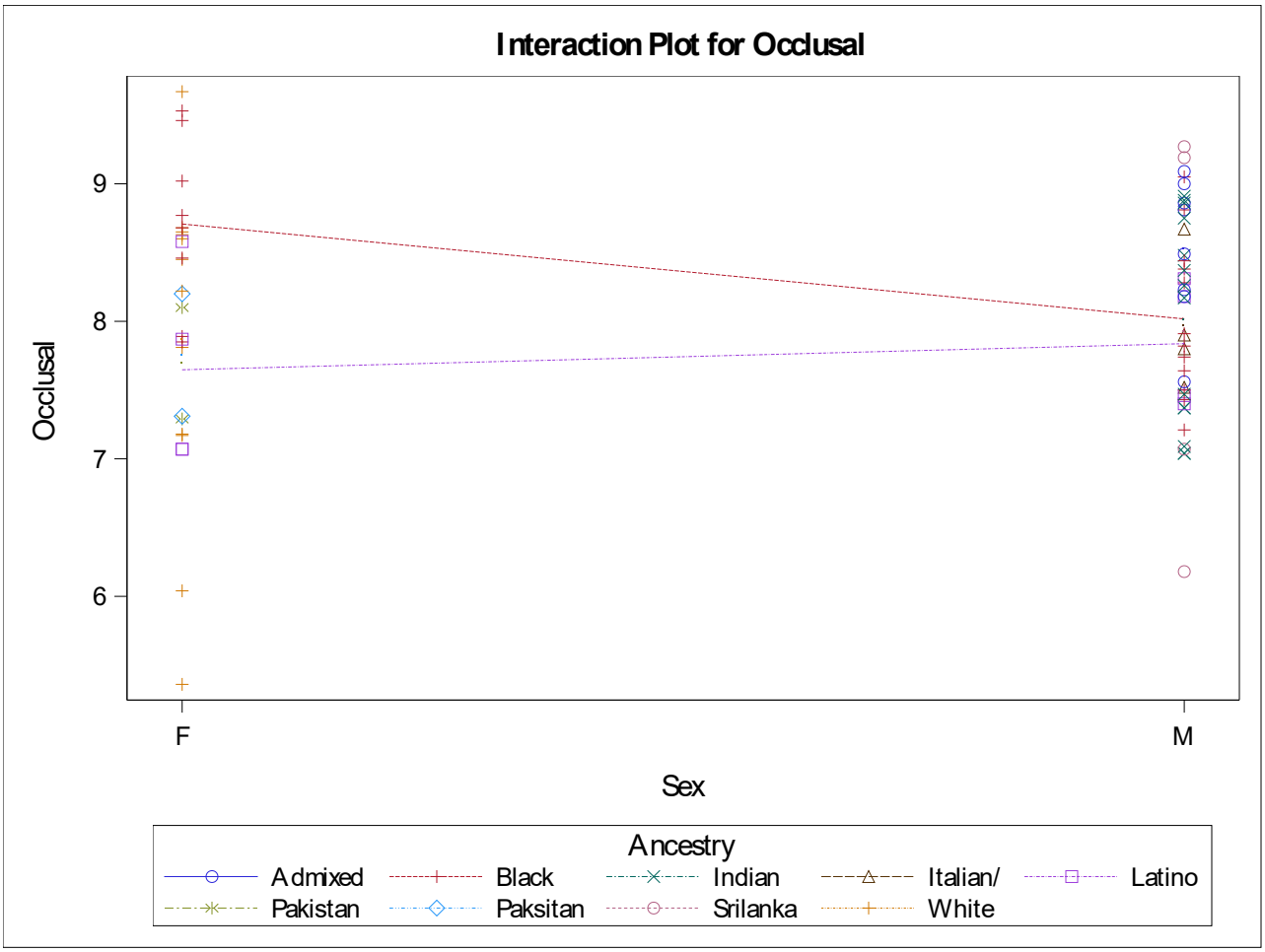
R-Square	Coeff Var	Root MSE	Occlusal Mean
0.140355	10.23936	0.826137	8.068243

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Sex	1	0.35294118	0.35294118	0.52	0.4747
Ancestry	8	5.35305450	0.66913181	0.98	0.4596
Sex*Ancestry	1	1.09327059	1.09327059	1.60	0.2103

The GLM Procedure

Dependent Variable: Occlusal

Group3=2 M2



According to the model of the analysis procedure as is, there is not much significance in the occlusal measurements of the second molar as the values of the probability for the given F ratio, Pr > F, after sum of squares,are not of very less values. When the type 3 sum of squares is calculated and considered, the variables – sex and ancestry do not show prominent significance and interactions as the values are more than .05. The interaction between sex and ancestry is not significant as the probability values do not lie within .05

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The GLM Procedure

Group3=2 PM1

Class Level Information		
Class	**Levels**	**Values**
Sex	2	F M
Ancestry	11	Admixed Black Indian Indian/I Indian/S Italian Italian/ Latino Pakistan Srilankan White

Data for Analysis of Mesiodistal BuccolingualCrownHeight	
Number of Observations Read	202
Number of Observations Used	74

Data for Analysis of Occlusal	
Number of Observations Read	202
Number of Observations Used	73

Data for Analysis of Incisal	
Number of Observations Read	202
Number of Observations Used	1

Note: Variable in each group are consistent with respect to presence or absence of missing values.

The GLM Procedure

Dependent Variable: Mesiodistal

Group3=2 PM1

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	9	11.10853829	1.23428203	5.20	<.0001
Error	64	15.19873333	0.23748021		
Corrected Total	73	26.30727162			

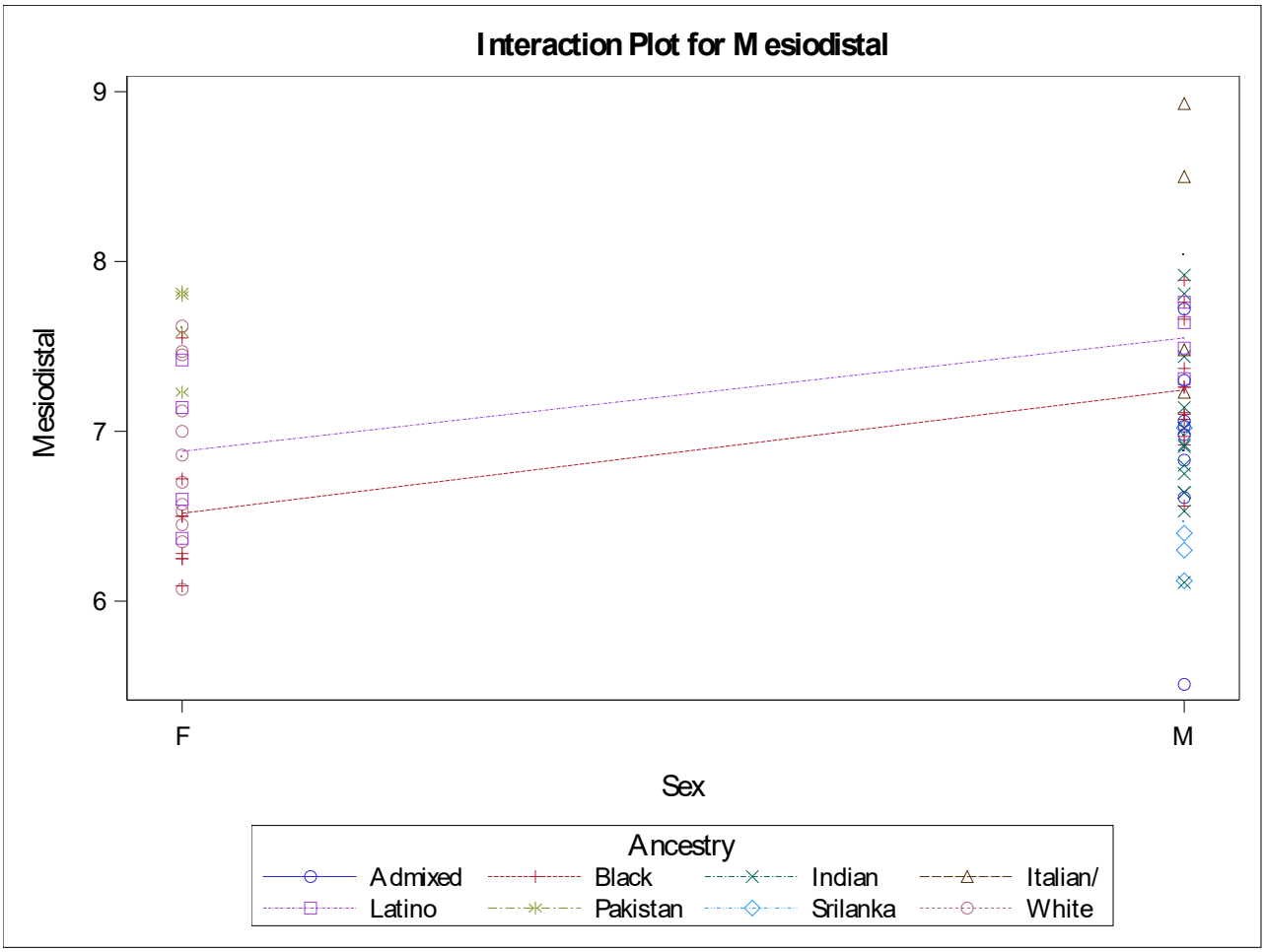
R-Square	Coeff Var	Root MSE	Mesiodistal Mean
0.422261	6.933730	0.487319	7.028243

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Sex	1	2.74404804	2.74404804	11.55	0.0012
Ancestry	7	9.68877981	1.38411140	5.83	<.0001
Sex*Ancestry	1	0.00494216	0.00494216	0.02	0.8857

The GLM Procedure

Dependent Variable: Mesiodistal

Group3=2 PM1



According to the model of the analysis procedure as is, there is not much significance in the mesiodistal measurements of the first premolar as the values of the probability for the given F ratio, Pr > F, after sum of squares,are not of very less values. When the type 3 sum of squares is calculated and considered, the variables – sex and ancestry show prominent significance and interactions as the values are less than .05. The interaction between sex and ancestry is not significant as the probability values do not lie within .05 .

The GLM Procedure

Dependent Variable: Buccolingual

Group3=2 PM1

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	9	21.78897970	2.42099774	2.48	0.0172
Error	64	62.58472976	0.97788640		
Corrected Total	73	84.37370946			

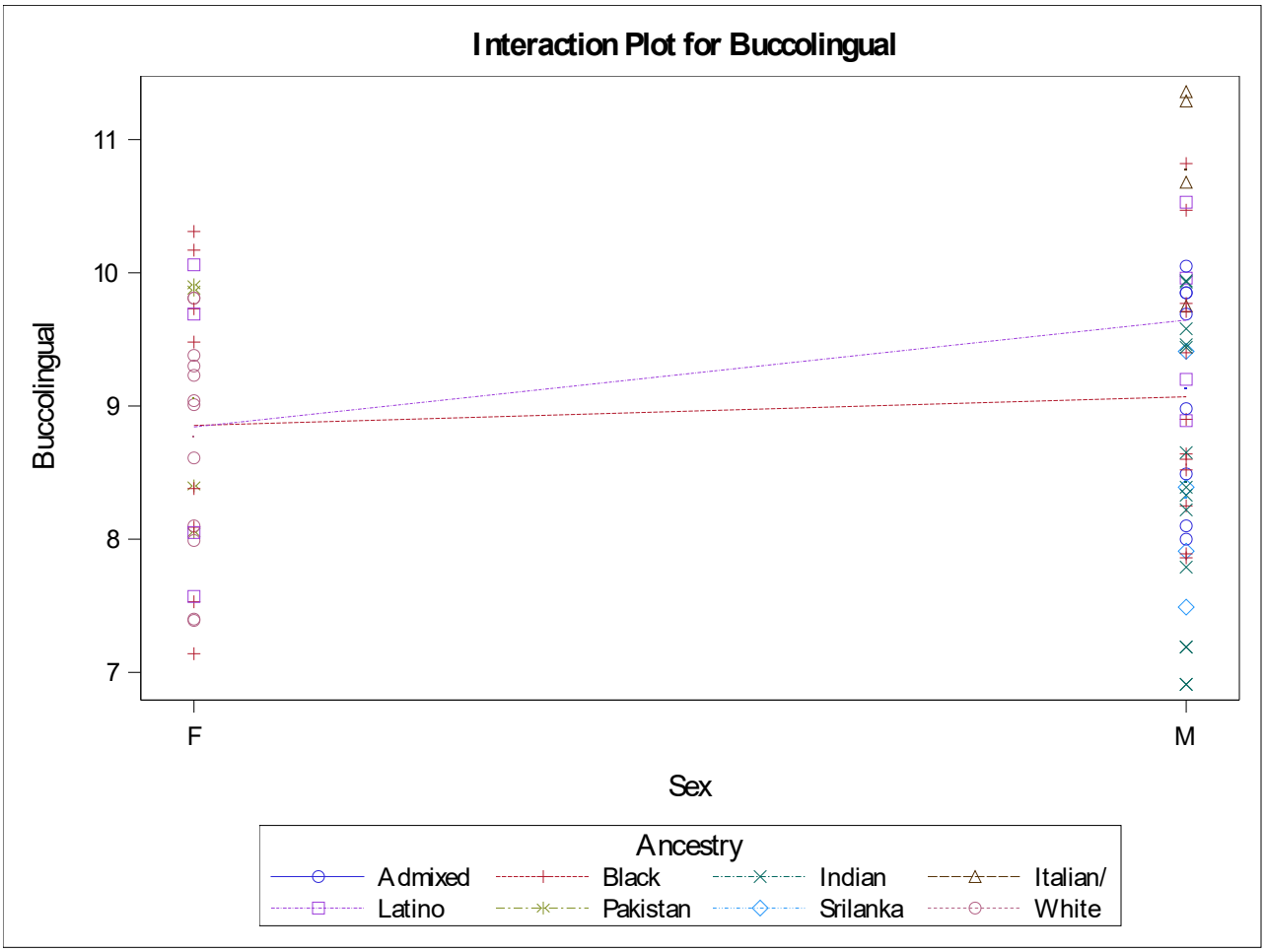
R-Square	Coeff Var	Root MSE	Buccolingual Mean
0.258244	11.05179	0.988881	8.947703

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Sex	1	1.46280613	1.46280613	1.50	0.2258
Ancestry	7	21.11162041	3.01594577	3.08	0.0073
Sex*Ancestry	1	0.48658848	0.48658848	0.50	0.4831

The GLM Procedure

Dependent Variable: Buccolingual

Group3=2 PM1



According to the model of the analysis procedure as is, there is significance in the buccolingual measurements of the first premolar molar as the values of the probability for the given F ratio, Pr > F, after sum of squares,are of very less values. When the type 3 sum of squares is calculated and considered, the variable – sex does not show significance with respect to this particular measurement, whereas the variable – ancestry shows prominent significance and interactions as the values are <.05 .The interaction between sex and ancestry is not significant as the probability values do not lie within .05 .

The GLM Procedure

Dependent Variable: CrownHeight

Group3=2 PM1

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	9	20.45696649	2.27299628	3.54	0.0013
Error	64	41.09494702	0.64210855		
Corrected Total	73	61.55191351			

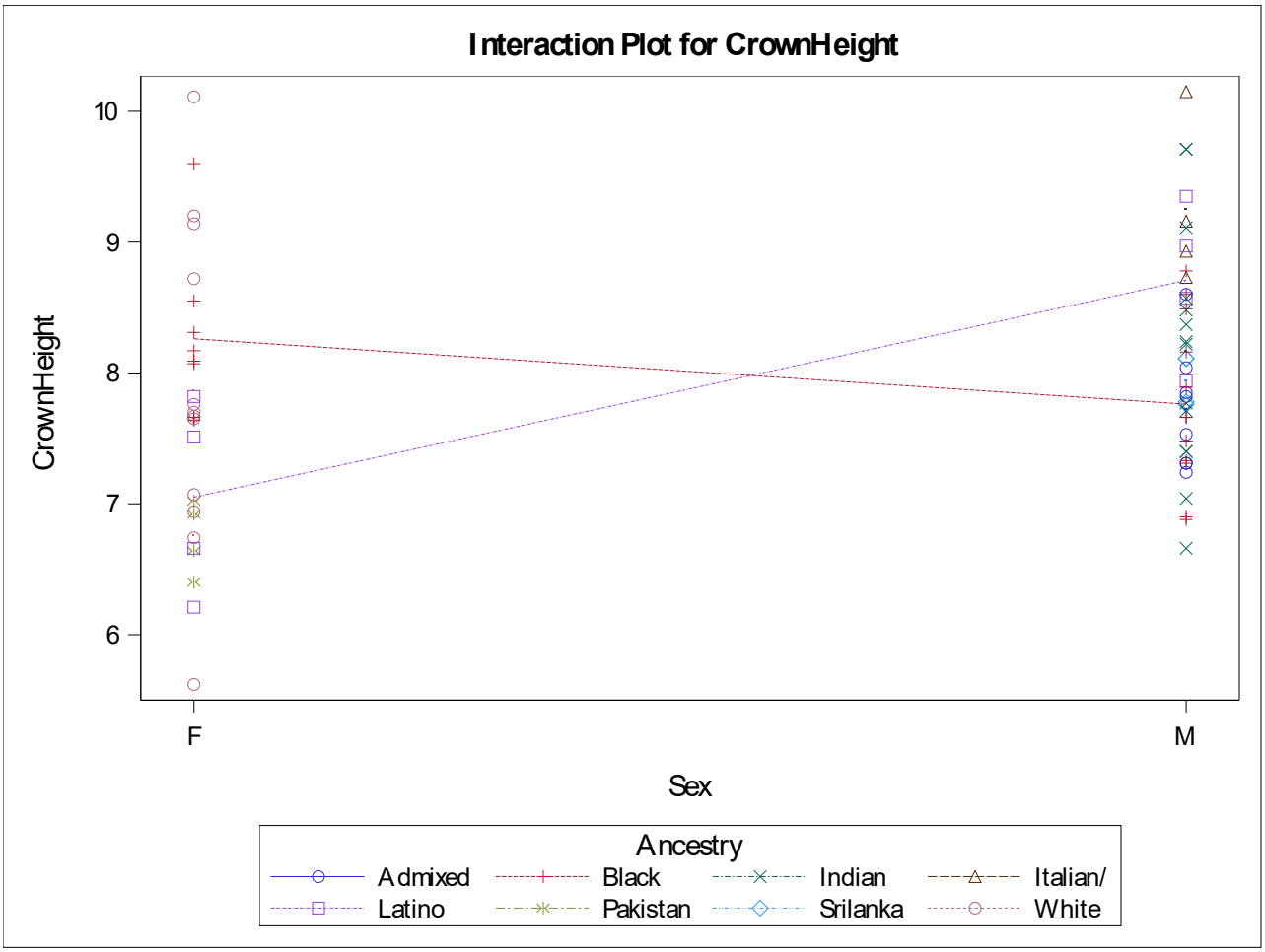
R-Square	Coeff Var	Root MSE	CrownHeight Mean
0.332353	10.07809	0.801317	7.951081

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Sex	1	1.89285319	1.89285319	2.95	0.0908
Ancestry	7	10.49047414	1.49863916	2.33	0.0347
Sex*Ancestry	1	6.56895319	6.56895319	10.23	0.0021

The GLM Procedure

Dependent Variable: CrownHeight

Group3=2 PM1



According to the model of the analysis procedure as is, there is much significance in the crown height measurements of the first premolar as the values of the probability for the given F ratio, Pr > F, after sum of squares,are of very less values. When the type 3 sum of squares is calculated and considered, the variable – sex does not show much significance with respect to this particular measurement, whereas the variable – ancestry shows prominent significance and interactions as the values are less than .05.The interaction between sex and ancestry is significant as the probability values lie within .05 .

The GLM Procedure

Dependent Variable: Occlusal

Group3=2 PM1

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	9	17.60839785	1.95648865	1.90	0.0686
Error	63	64.96778571	1.03123469		
Corrected Total	72	82.57618356			

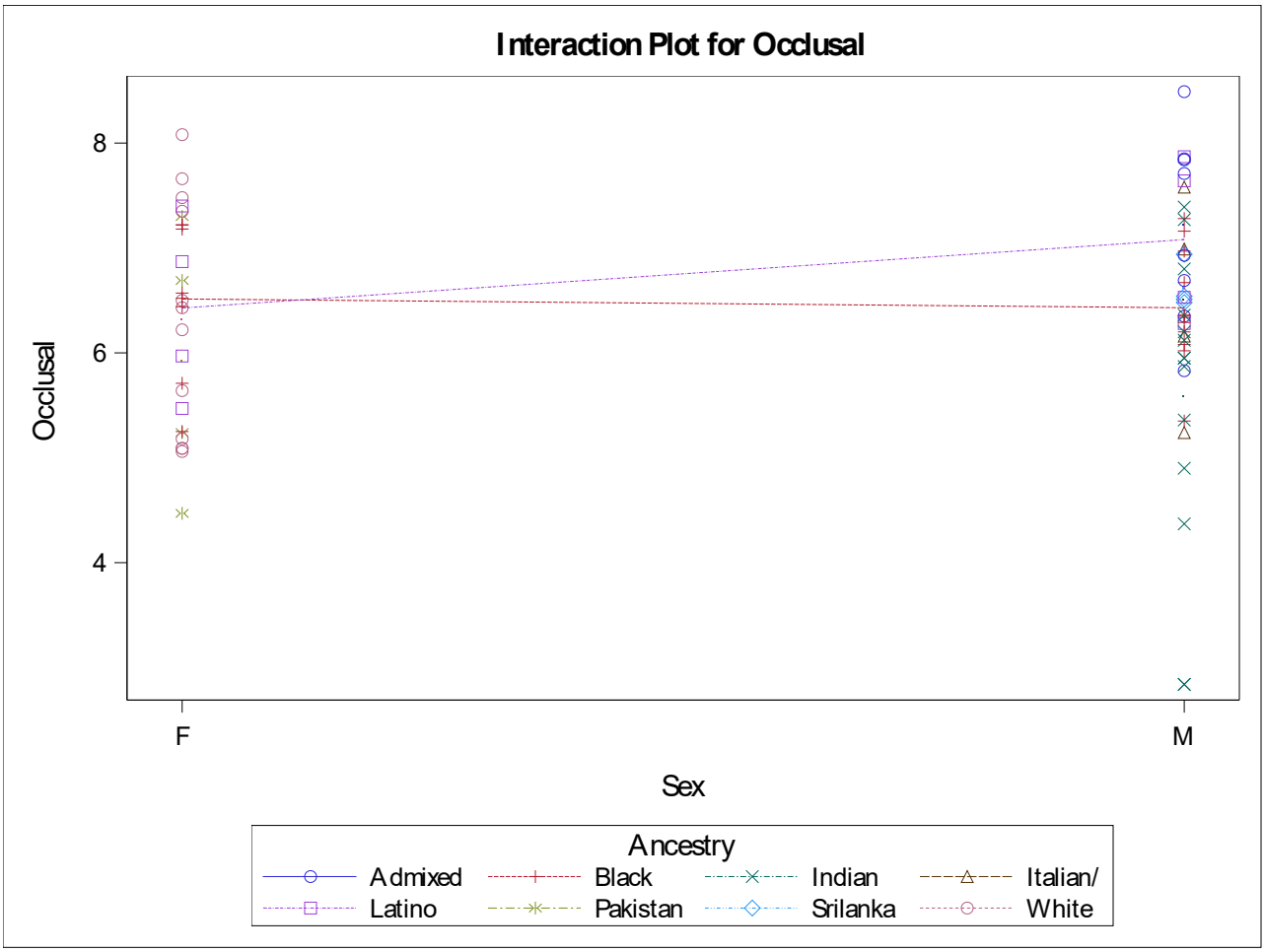
R-Square	Coeff Var	Root MSE	Occlusal Mean
0.213238	15.95251	1.015497	6.365753

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Sex	1	0.45184028	0.45184028	0.44	0.5104
Ancestry	7	17.10940585	2.44420084	2.37	0.0324
Sex*Ancestry	1	0.75716885	0.75716885	0.73	0.3948

The GLM Procedure

Dependent Variable: Occlusal

Group3=2 PM1



According to the model of the analysis procedure as is, there is not much significance in the occlusal measurements of the first premolar as the values of the probability for the given F ratio, Pr > F, after sum of squares,are not of less values. When the type 3 sum of squares is calculated and considered, the variable – sex does not show much significance with respect to this particular measurement, whereas the variable – ancestry shows prominent significance and interactions as the values are <.05.The interaction between sex and ancestry is not significant as the probability values do not lie within .05 .

The GLM Procedure

Dependent Variable: Incisal

Group3=2 PM1

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	0	0	.	.	.
Error	0	0	.		
Corrected Total	0	0			

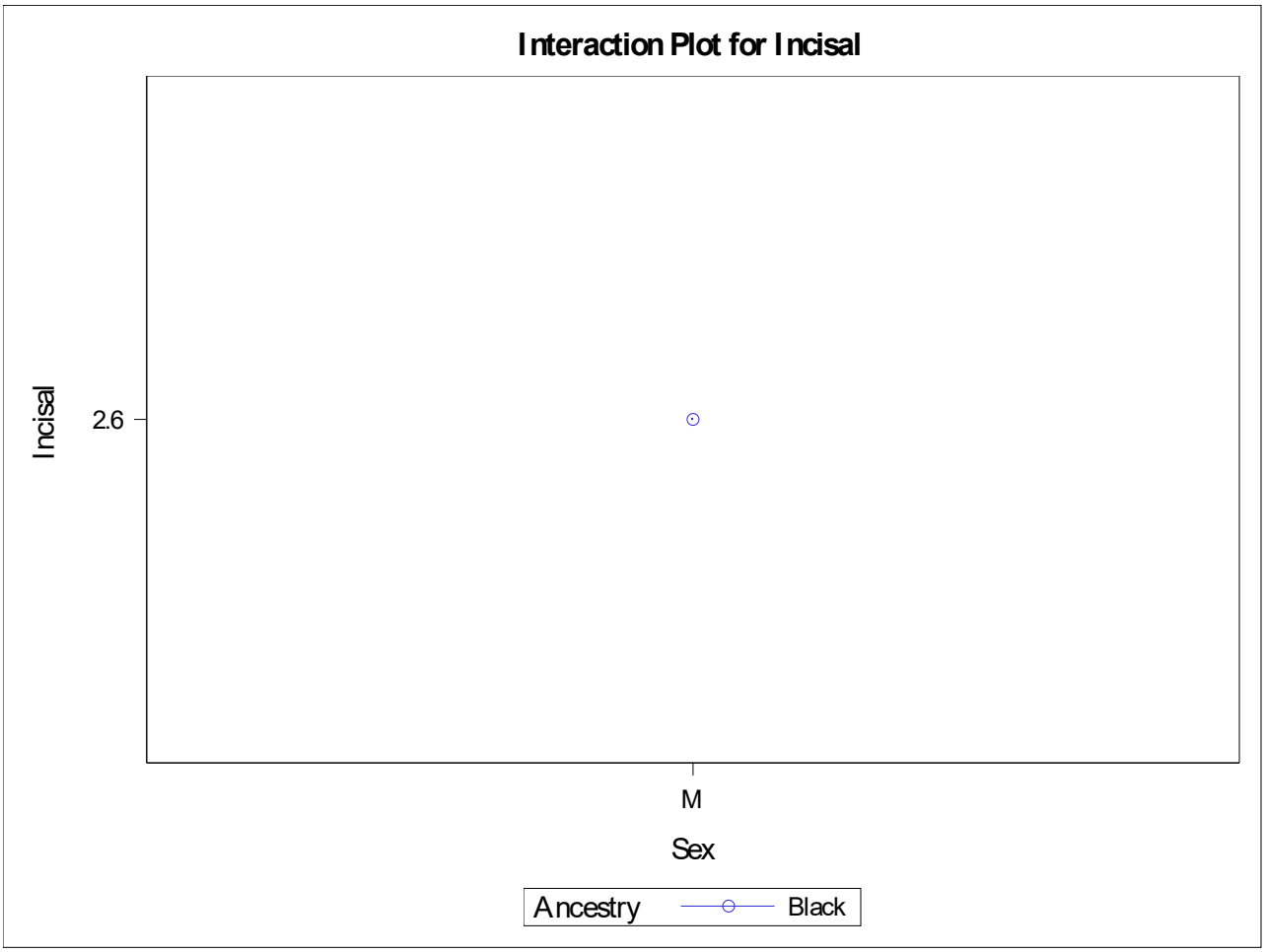
R-Square	Coeff Var	Root MSE	Incisal Mean
0.000000	.	.	2.600000

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Sex	0	0	.	.	.
Ancestry	0	0	.	.	.
Sex*Ancestry	0	0	.	.	.

The GLM Procedure

Dependent Variable: Incisal

Group3=2 PM1



Since the cutting and chewing surface of anterior teeth such as the canines, are known as incisal edges and occlusal surfaces are solely meant for those of the posterior teeth such as the premolars and molars, the first premolar does not have an incisal measurement.

The GLM Procedure

Group3=2 PM2

Class Level Information		
Class	**Levels**	**Values**
Sex	2	F M
Ancestry	11	Admixed Black Indian Indian/I Indian/S Italian Italian/ Latino Pakistan Srilankan White

Data for Analysis of Incisal	
Number of Observations Read	202
Number of Observations Used	0

Data for Analysis of Mesiodistal Buccolingual CrownHeight Occlusal	
Number of Observations Read	202
Number of Observations Used	74

Note: Variable in each group are consistent with respect to presence or absence of missing values.

The GLM Procedure

Dependent Variable: Mesiodistal

Group3=2 PM2

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	9	10.97772268	1.21974696	3.26	0.0025
Error	64	23.94401786	0.37412528		
Corrected Total	73	34.92174054			

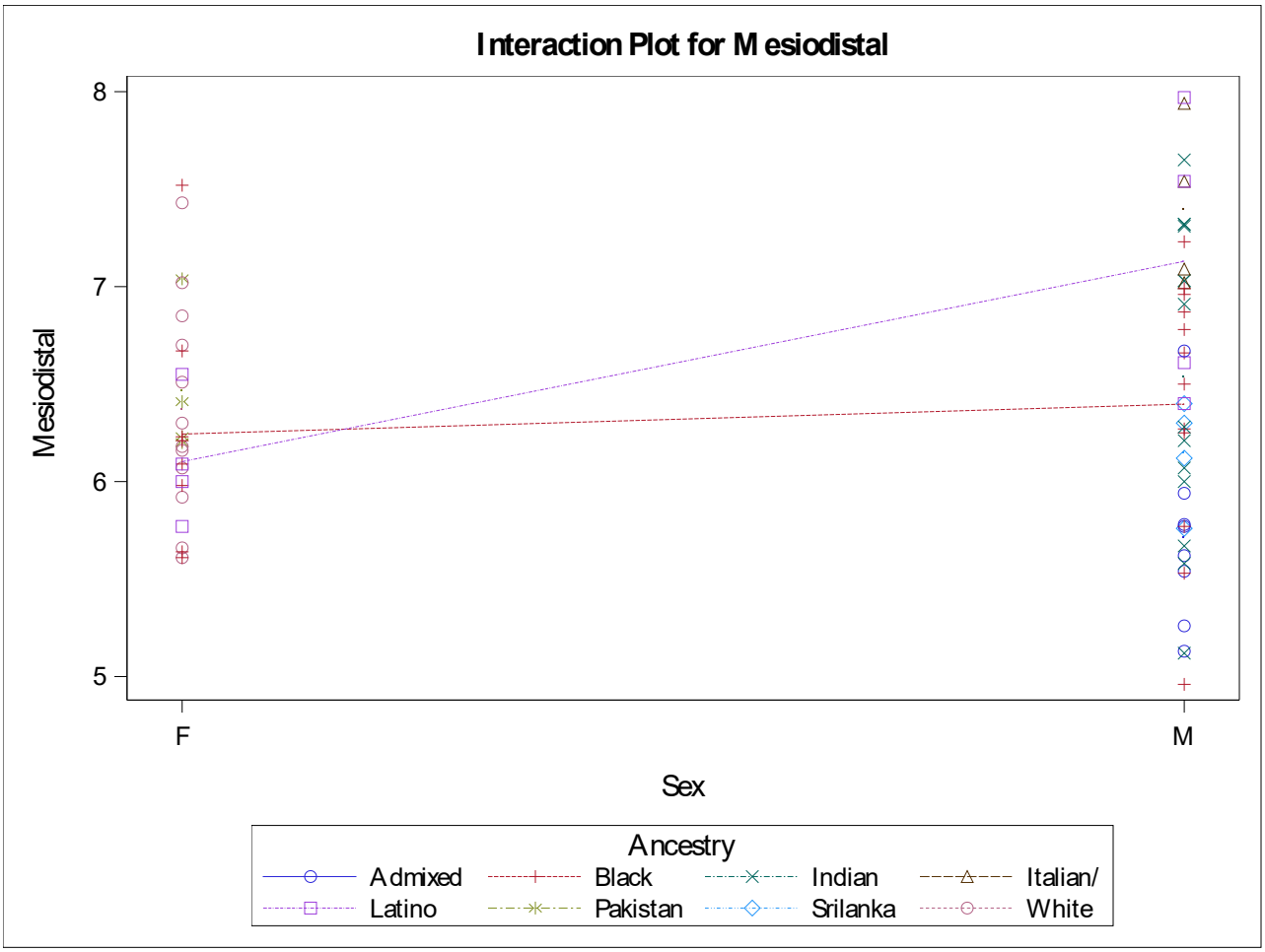
R-Square	Coeff Var	Root MSE	Mesiodistal Mean
0.314352	9.562807	0.611658	6.396216

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Sex	1	1.96990809	1.96990809	5.27	0.0250
Ancestry	7	10.12312117	1.44616017	3.87	0.0014
Sex*Ancestry	1	1.07779632	1.07779632	2.88	0.0945

The GLM Procedure

Dependent Variable: Mesiodistal

Group3=2 PM2



According to the model of the analysis procedure as is, there is much significance in the mesiodistal measurements of the second premolar as the values of the probability for the given F ratio, Pr > F, after sum of squares,are of very less values. When the type 3 sum of squares is calculated and considered, the variables – sex and ancestry show prominent significance and interactions as the values are less than .05. The interaction between sex and ancestry is not significant as the probability values do not lie within .05 .

The GLM Procedure

Dependent Variable: Buccolingual

Group3=2 PM2

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	9	12.61513557	1.40168173	4.48	0.0001
Error	64	20.03209821	0.31300153		
Corrected Total	73	32.64723378			

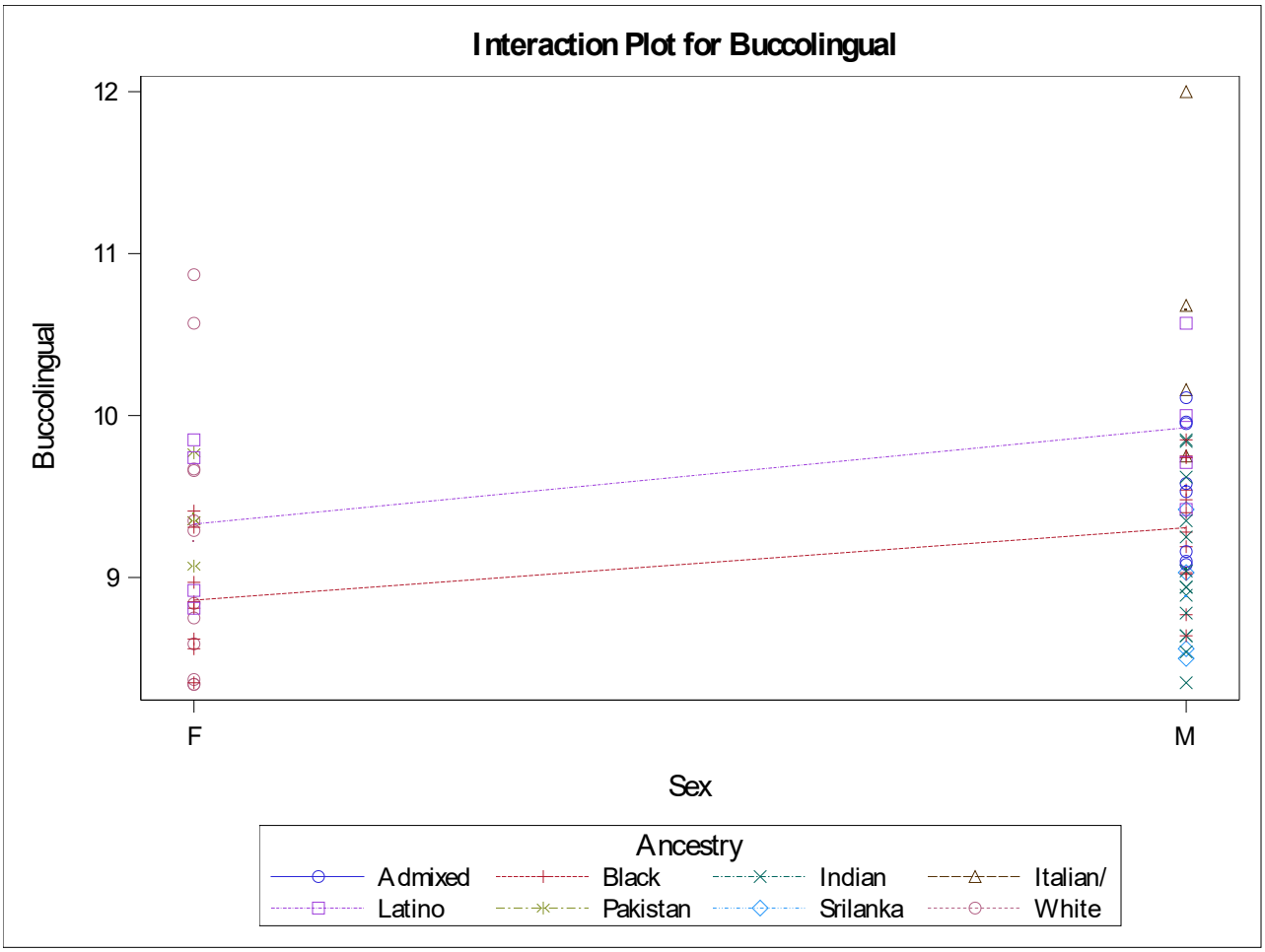
R-Square	Coeff Var	Root MSE	Buccolingual Mean
0.386407	6.008685	0.559465	9.310946

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Sex	1	1.53431471	1.53431471	4.90	0.0304
Ancestry	7	11.53839031	1.64834147	5.27	<.0001
Sex*Ancestry	1	0.03071471	0.03071471	0.10	0.7551

The GLM Procedure

Dependent Variable: Buccolingual

Group3=2 PM2

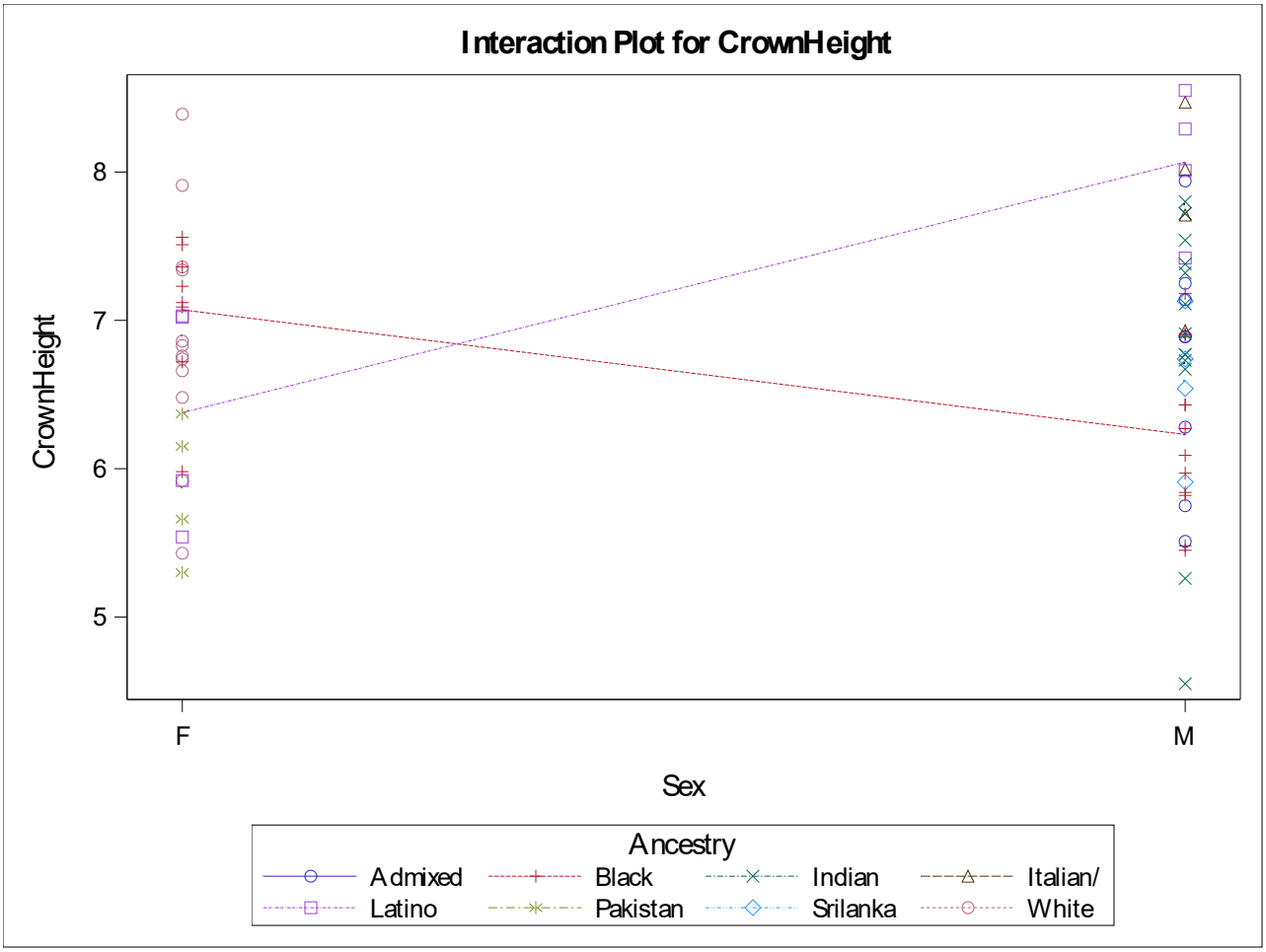


According to the model of the analysis procedure as is, there is much significance in the buccolingual measurements of the second premolar as the values of the probability for the given F ratio, Pr > F, after sum of squares,are of very less values. When the type 3 sum of squares is calculated and considered, the variables – sex and ancestry show prominent significance and interactions as the values are less than .05.The interaction between sex and ancestry is not significant as the probability values do not lie within .05 .

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	9	19.37256779	2.15250753	4.11	0.0003
Error	64	33.50794167	0.52356159		
Corrected Total	73	52.88050946			

R-Square	Coeff Var	Root MSE	CrownHeight Mean
0.366346	10.65288	0.723576	6.792297

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Sex	1	1.01900025	1.01900025	1.95	0.1678
Ancestry	7	8.89461406	1.27065915	2.43	0.0286
Sex*Ancestry	1	9.03954142	9.03954142	17.27	<.0001



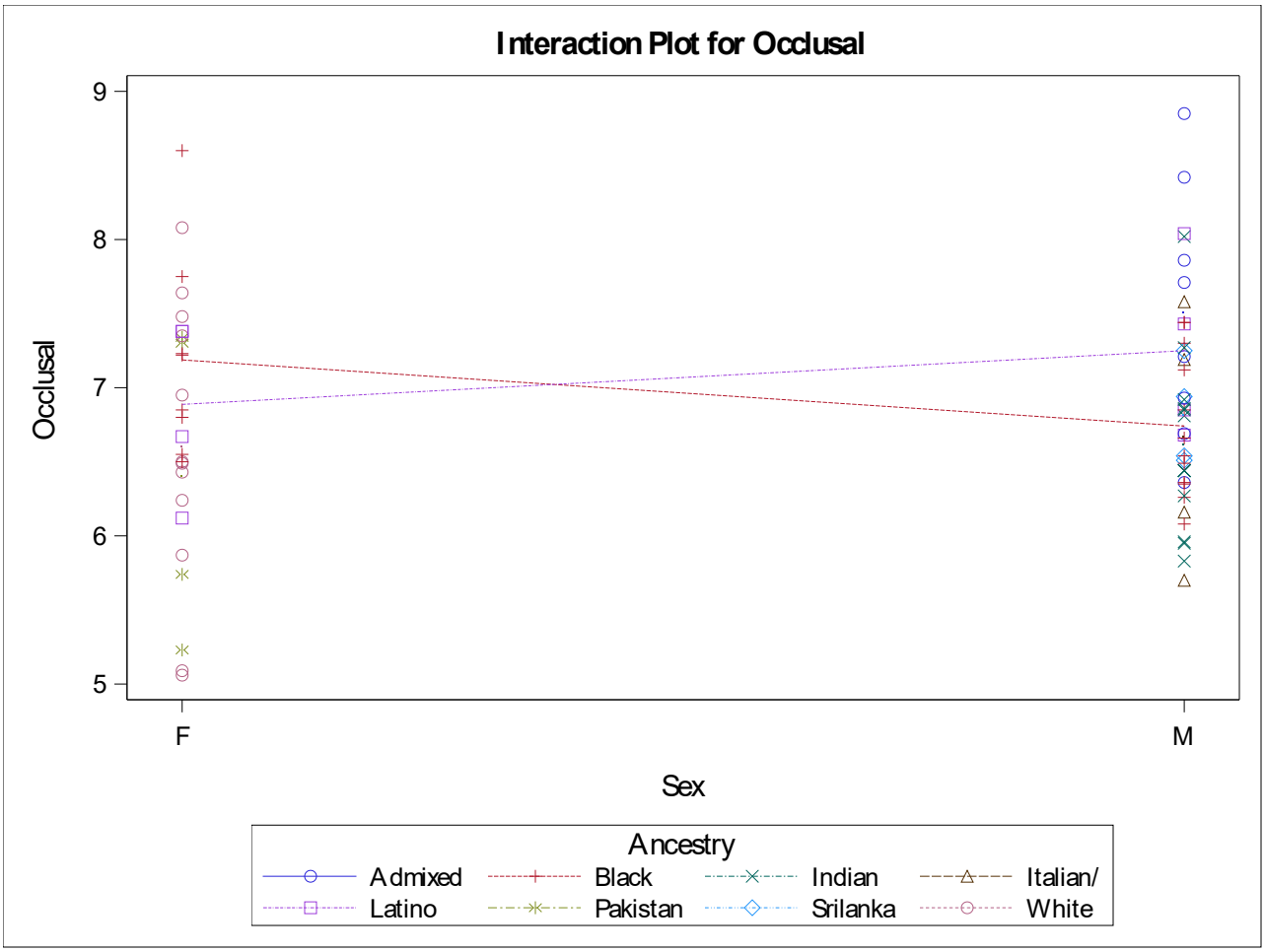
According to the model of the analysis procedure as is, there is much significance in the crown height measurements of the second premolar as the values of the probability for the given F ratio, Pr > F, after sum of squares,are of very less values.

When the type 3 sum of squares is calculated and considered, the variable – sex does not show much significance with respect to this particular measurement, whereas the variable – ancestry shows prominent significance and interactions as the values are less than .05. The interaction between sex and ancestry is significant as the probability values lie within .05 .

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	9	7.65238129	0.85026459	1.60	0.1355
Error	64	34.09350655	0.53271104		
Corrected Total	73	41.74588784			

R-Square	Coeff Var	Root MSE	Occlusal Mean
0.183309	10.67125	0.729871	6.839595

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Sex	1	0.01000098	0.01000098	0.02	0.8914
Ancestry	7	6.13411359	0.87630194	1.64	0.1390
Sex*Ancestry	1	0.92435392	0.92435392	1.74	0.1924



According to the model of the analysis procedure as is, there is not much significance in the occlusal measurements of the second premolar as the values of the probability for the given F ratio, Pr > F, after sum of squares,are not of very less values.

When the type 3 sum of squares is calculated and considered, the variables – sex and ancestry do not show much significance with respect to this particular measurement, as the values are more than .05.

The interaction between sex and ancestry is not significant as the probability values do not lie within .05 .

VI . RESULTS AND DISCUSSION :

The results expected from this project are to be able to aid the forensic scientists to identify the individuals based on their ancestry when all the other methods of identification are not fruitful. From the data generated, both sex differences and ancestral differences are expected to be interpreted after analyzing and differentiating/classifying into groups based on male and female ancestral lines individually (Pilloud et al, 2014; Peckmann, Meek, Dilkie & Mussett, 2015). From the results of this analysis, it could be inferred that there are ancestral differences even in the measurement of teeth alone. Though there are sexual dimorphism differences as well, the ancestral variations are more predominantly pronounced. The significance is to be able to provide a template to refer to for the measurements and dimensions in future real life scenarios by putting it to use practically.

VII. CONCLUSION:

The conclusion, in this study, is to provide a suitable range for each ancestral line according to the dimensions of the tooth. A literature mentions about a statistical data package that could be formed if more and more researchers are able to find data about correlation between teeth dimensions and ancestry using FORDISC (Pilloud et al, 2014). When a bigger sample size is collected, FORDISC may be used, as it would be able to discriminate and be able to provide results for individuals who are yet to be identified. The future researchers could use the data by amplifying their sample size in order to make a substantial template for the ancestral groups that the forensic investigation agencies could use reliably. It may be concluded that the teeth are a promising tool for the estimation of ancestry and sex of unknown individuals as they provide significant reliability and interactions as observed from the data collected.

VIII . REFERENCES

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