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CBCT Evaluation of Adolescent Mandibular Morphology in Different Classifications of Facial Type

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CBCT EVALUATION OF ADOLESCENT MANDIBULAR MORPHOLOGY IN DIFFERENT CLASSIFICATIONS OF FACIAL TYPE

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Abstract

CBCT Evaluation of Adolescent Mandibular Morphology in Different Classifications of Facial Type

By

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The goal of this study is to use the improved imaging capability of cone-beam computerized tomography (CBCT) to investigate the relationship between vertical facial patterns and mandibular tooth-alveolar morphology in the adolescent population. Pre-treatment orthodontic records were obtained from the UNLV School of Dental Medicine archival dental records. One hundred and seventy three patients (72 males, 101 females) between the ages of 12 and 18 years were included in this study. Among these patients, 61 displayed the vertical growth pattern, 30 displayed the horizontal growth pattern, and 82 displayed the average growth pattern. The samples were categorized into 4 age groups for analysis: Group 1 (age 12 to 18), Group 2 (age 12 to 13), Group 3 (age 14 to 15), and Group 4 (age 16 to 18). Cross sectional slices of the mandible were developed from the cone-beam scans to evaluate cortical bone thickness, alveolar bone height, alveolar bone width, tooth inclination, and alveolar bone inclination at four locations. Each cross section was measured at 10 sites, which included 5 cortical bone thickness, 1 height, 2 width, 1 tooth inclination, and 1 bone inclination measurements. An analysis of variance (ANOVA) with post-hoc Scheffé statistical analysis was used with a significance level of $p < 0.05$. Results of this study indicated that in all age groups the hyperdivergent facial type generally had the thinnest cortical bone, the highest alveolar bone height at the anterior region of the mandible, and the narrowest alveolar bone width compared with the other two facial types. The hyperdivergent facial type had more upright lower incisor and more lingually inclined posterior teeth than the other facial types. The alveolar bone inclination generally followed the same angulation tendency as the tooth inclination. The results of this study indicates statistically significant differences exist in cortical bone thickness, alveolar bone height, alveolar bone width, tooth inclination, and bone inclination measurements between the various facial types in the adolescent population.

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Lastly, I would like to thank my entire family for providing me with unconditional love and support. In particular, I must acknowledge my husband and best friend, Steve, without whose love and encouragement I would not have finished this thesis.

Dedication

To my husband Steve and daughter Natalie,

Thank you for always believing in me and for all of your support.

I love you both more than words can say.

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Chapter 1: Introduction

Vertical facial morphology and its effect on the outcome of orthodontic treatment is of great interest for clinicians because the amount and direction of facial growth may alter biomechanics, treatment plans, and ultimately outcomes (Schudy, 1964). There are important changes in vertical facial dimension during the growth of the craniofacial region, and short, average, and long facial types have distinguishing morphological and functional differences (Bjork, 1969; Bjork & Skieller, 1972; Bresin, Kiliaridis, & Strid, 1999; Schudy, 1964; Skieller, Bjork, & Lende-Hansen 1984).

Past studies that have investigated craniofacial growth and vertical facial morphology used lateral cephalograms and metallic implants as methods of research. In some of these studies, researchers placed metallic implants in various stable regions of the maxilla and mandible and then traced and superimposed the annual lateral cephalograms (Bjork, 1955). The researchers then studied the vertical development of the face and the subsequent compensatory changes in mandibular rotation and teeth with the implants as reference points. These studies have established that hypodivergent individuals are characterized by shorter lower anterior face height with longer posterior face height and have more forward rotation of the mandible during growth (Bjork, 1969; Bjork & Skieller, 1972). Because of the more upward and forward position of the mandible, the short-faced individual therefore tends to have a more horizontal palatal plane and a lower mandibular plane angle. In addition, a deep bite malocclusion tends to occur because as the mandible rotates upward and forward, the vertical overlap of the teeth tends to increase (Bjork, 1969; Bjork & Skieller, 1972). The hypodivergent individual has a short and wide face with a square mandible and wide dental arches (Ricketts, Roth, Chaconas, Schulhhof, & Engel, 1982).

Conversely, hyperdivergent individuals typically have longer lower anterior face height with shorter posterior face height and have more backward rotation of the mandible during growth (Bjork, 1969; Bjork & Skieller, 1972). Because of the downward and backward position of the mandible, the long-faced patient therefore tends to have a steeper palatal plane and a higher mandibular plane angle. Since the mandible rotates backward, there is a tendency for anterior open bite and mandibular incisor protrusion to develop (Bjork, 1969; Bjork & Skieller, 1972). The hyperdivergent individual has a long and narrow face with weak muscles and an obtuse mandibular gonial angle (Ricketts et al., 1982).

It is believed that mandibular rotation, mandibular plane, occlusal plane, gonial angle, occlusion, dental arch forms, mandibular shapes, cortical bone thickness, and tooth inclinations are different between the three groups (Bjork, 1969; Bjork & Skieller, 1972; Bresin et al., 1999; Schudy, 1964; Skieller et al., 1984). Among these variations, the differences in the tooth-alveolar bone complex between the facial types are especially important in orthodontic treatment planning and the subsequent success of treatment. Knowledge of the variants in buccolingual inclination of mandibular incisors and molars between the facial types allows for proper treatment planning to ensure a stable occlusion. The knowledge of the alveolar bone morphology also assists in determining the location and placement of temporary anchorage devices in order to achieve maximum stability. An understanding of the post-treatment growth tendencies further assists clinicians in making therapeutic decisions that ensure post-treatment stability. Thus, for many reasons, it is important to understand and investigate the morphological characteristics of the mandibular body and its relationship to facial type.

Researchers have investigated the relationship between vertical facial pattern and mandibular tooth-alveolar morphology in the past. However, the limitations of these earlier studies are that the sample sizes were small and the study populations consisted only of computed tomography (CT) scans of dry skulls of male Asiatic Indians or modern Japanese males (Kasai et al., 1995; Kohakura, Kasai, Ohno & Kanazawa, 1997; Masumoto, Hayashi, Kawamura, Tanaka, & Kasai, 2001; Tsunori, Mashita, & Kasai, 1998). The appearance of cone-beam computerized tomography (CBCT) technology has opened new possibilities for dental and maxillofacial assessment and research. However, CBCT studies evaluating the relationships between mandibular tooth-alveolar morphology and facial types have been insufficient in number and scope (Han et al., 2013; Horner, Behrents, Kim, & Buschang, 2012; Ozdemir, Tozlu, & Germec-Cakan, 2013; Sadek, Sabet, & Hassan, 2014; Swasty et al., 2011). Previous CBCT research focused mainly on the adult population and only evaluated limited aspects of the tooth-alveolar mandibular morphology. In addition, there are some conflicting findings derived from these studies.

Purpose of Study

The purpose of this study is to conduct a broad evaluation of the mandibular tooth-alveolar morphology as related to different facial divergences in the adolescent population. This study uses the improved imaging capability of the CBCT to analyze a broader set of data points for a set of subjects more representative of the orthodontic treatment population. Specifically, measurements were taken of the cortical bone thickness, height of the alveolar bone, width of the alveolar bone, buccolingual inclination of teeth, and buccolingual inclination of the alveolar bone at four locations in the mandible for male and female subjects between the ages of 12 and 18 years. These measurements have then been correlated with facial type. Since the majority of the studies performed previously focused on adults, this project's focus on adolescents was designed to identify and assess issues that are likely to arise in orthodontic practice.

Research Questions and Hypothesis

1. Is there a difference in the mandibular buccal cortical bone thickness between adolescents with normodivergent, hypodivergent, and hyperdivergent facial types?

Hypothesis: There is a difference in the mandibular buccal cortical bone thickness between adolescents with normodivergent, hypodivergent, and hyperdivergent facial types.

Null Hypothesis: There is no difference in the mandibular buccal cortical bone thickness between adolescents with normodivergent, hypodivergent, and hyperdivergent facial types.

2. Is there a difference in the mandibular lingual cortical bone thickness between adolescents with normodivergent, hypodivergent, and hyperdivergent facial types?

Hypothesis: There is a difference in the mandibular lingual cortical bone thickness between adolescents with normodivergent, hypodivergent, and hyperdivergent facial types.

Null Hypothesis: There is no difference in mandibular lingual cortical bone thickness between adolescents with normodivergent, hypodivergent, and hyperdivergent facial types.

3. Is there a difference in the mandibular alveolar bone height between adolescents with normodivergent, hypodivergent, and hyperdivergent facial types?

Hypothesis: There is a difference in the mandibular alveolar bone height between adolescents with normodivergent, hypodivergent, and hyperdivergent facial types.

Null Hypothesis: There is no difference in the mandibular alveolar bone height between adolescents with normodivergent, hypodivergent, and hyperdivergent facial types.

4. Is there a difference in the mandibular alveolar bone width between adolescents with normodivergent, hypodivergent, and hyperdivergent facial types?

Hypothesis: There is a difference in the mandibular alveolar bone width between adolescents with normodivergent, hypodivergent, and hyperdivergent facial types.

Null Hypothesis: There is no difference in the mandibular alveolar bone width between adolescents with normodivergent, hypodivergent, and hyperdivergent facial types.

5. Is there a difference in the buccolingual tooth inclination between adolescents with normodivergent, hypodivergent, and hyperdivergent facial types?

Hypothesis: There is a difference in the buccolingual tooth inclination between adolescents with normodivergent, hypodivergent, and hyperdivergent facial types.

Null Hypothesis: There is no difference in the buccolingual tooth inclination between adolescents with normodivergent, hypodivergent, and hyperdivergent facial types.

6. Is there a difference in the buccolingual inclination of mandibular alveolar bone between adolescents with normodivergent, hypodivergent, and hyperdivergent facial types?

Hypothesis: There is a difference in the buccolingual inclination of mandibular alveolar bone between adolescents with normodivergent, hypodivergent, and hyperdivergent facial types.

Null Hypothesis: There is no difference in the buccolingual inclination of mandibular alveolar bone in adolescents with normodivergent, hypodivergent, and hyperdivergent facial types.

Chapter 2: Literature Review

Vertical Facial Types

The understanding of vertical facial growth and its implications with regard to treatment are important topics in orthodontics. Two facial forms, namely the hyperdivergent and hypodivergent facial types, have been studied extensively. Hyperdivergent individuals have been characterized as having a skeletal open bite or a long face while hypodivergent individuals have been characterized as having a skeletal deep bite or a short face (Schendel et al., 1976, Schudy, 1964). Researchers have conducted various studies to understand vertical facial growth and its implications in orthodontics. In 1964, a study investigated the relationship between posterior and anterior face height cross-sectionally using 270 patients with an age range of 11 to 14 years (Schudy, 1964). Researchers concluded, based on measurements of lateral cephalograms, that the total and lower anterior facial heights were larger and the mandibular plane angles were higher in the skeletal open bite subjects than in the skeletal deep bite subjects. Other investigators made similar observations in 1976 and 1984 (Fields, Proffit, Nixon, & Stanek, 1984; Schendel et al., 1976). The 1976 study used 31 patients with an age range of 17 to 25 years with vertical maxillary excess (Schendel et al., 1976). Various angular and linear measurements were made on lateral cephalograms and the conclusion was that the total anterior face height, and in particular, the lower anterior face height, was increased in patients with a long face. It was also discovered that the two variants of the long-faced type are those who have an open bite and those who have a non-open bite. Those who have a long face but no open bite have an increased ramus height. Both groups have a high mandibular plane angle and a normal upper lip length with an excess display of maxillary anterior teeth (Schendel et al., 1976). The

1984 study also concluded that long faces are also associated with higher Sella-Nasion to Mandibular Plane (SN-MP) angles (Fields et al., 1984)

Longitudinal studies of craniofacial growth utilizing metallic implants inserted in jaws found that forward mandibular condylar growth rotation is associated with the short face cases while a backward mandibular condylar growth rotation is associated with the long face cases (Bjork, 1969; Bjork & Skieller, 1972). These studies investigated growth changes in a sample of 100 children of each sex covering the ages of 4 to 24 years. Researchers examined growth changes using metallic implants placed in stable sites in the maxilla and mandible, and then traced and superimposed annual lateral cephalograms. Researchers then studied the vertical development of the face and the subsequent compensatory changes in mandibular rotation and teeth with the implants as reference points. The studies found that with the short-faced types the more forward rotation results in a more horizontal palatal plane, a lower mandibular plane angle, and a larger gonial angle. In addition, when excessive rotation of the jaw occurs, the incisors tend to move into an overlapping position and therefore the tendency for a deep bite develops (Bjork, 1969; Bjork & Skieller, 1972). Conversely, with the long-faced types the more backward rotation of the mandible leads to a steeper palatal plane, a higher mandibular plane angle, and a smaller gonial angle. With an anterior open bite, incisors will need to erupt for a greater distance. The rotation of the jaws will then carry the incisor forward and result in dental protrusion (Bjork, 1969; Bjork & Skieller, 1972).

Studies also indicate that there are biomechanical differences between vertical facial types which result in morphologic and functional differences. The size and orientation of the masticatory muscles and the forces that they generate affect the development of the maxillofacial complex and facial divergence (Chan, Woods, & Stella, 2008; Satiroglu, Arun, & Isik, 2005).

There is an association between increased facial divergence and reduced muscle function (Garcia-Morales, Buschang, Throckmorton, & English, 2003). Density and thickness of the cortical bone of the mandible and maxilla also adapt to masticatory forces and therefore result in different maxillomandibular morphology between the facial types. Reduced muscle function correlates with a reduced amount of cortical and trabecular bone in the dentoalveolar process (Bresin et al., 1999; Ichim, Kieser, & Swain, 2007). The forces generated by the masticatory muscles affect the occlusion, dental arch forms, and mandibular morphology.

The various studies on vertical facial dimensions indicate significant differences in craniofacial morphology and function between the hyperdivergent, normodivergent, and hypodivergent facial types. These differences warrant additional investigation as this knowledge will aid the orthodontic clinician in treatment planning and achieving stable results.

Computed Tomography (CT) versus Cone Beam Computed Tomography (CBCT)

Traditional two dimensional imaging techniques used in the orthodontic specialty such as the panoramic radiograph or the lateral cephalometric radiograph have the disadvantages of magnification, distortion, and superimposition of structures (Farman & Scarfe, 2009). Due to the many limitations of these two dimensional image views, there has been a shift toward a three dimensional approach to data acquisition and image reconstruction including the use of computed tomography (CT) and cone beam computed tomography (CBCT) (Mah & Hatcher, 2004). Three dimensional imaging are composed of voxels instead of pixels used in two dimensional images. Voxels have height, width, and thickness. All computed tomography scanners consist of an x-ray source and a detector mounted on a rotating gantry. As the gantry rotates, the receptor detects x-rays attenuated by the patient. A computer algorithm then reconstructs the data collected to generate cross-sectional images (Farman & Scarfe, 2009)

Computed tomography can be categorized based on x-ray beam geometry as either fan beam CT or cone beam CT. Most hospital CT scanners use a fan-shaped x-ray beam and images are produced in axial plane slices. These slices need to be reassembled in the correct orientation to construct the volume from which subsequent reoriented slices can be made. The resultant voxels are not uniform in all planes, which means that the precision in some measurements can be compromised. CBCT scanners use a cone-shaped x-ray beam so that a single C-arm rotation generates several hundred basis images of raw data, which are reconstructed to produce the complete dental or maxillofacial volume. The measurements are generally precise in all dimensions because the voxels are isotropic, or uniform, in all planes (Farman & Scarfe, 2009; Mah & Hatcher, 2004).

CBCT offers several advantages over CT as the preferred imaging modality for dental and orthodontic assessment. Since CBCT provides quality images of high contrasting structures, it improves the ability to evaluate calcified structures such as tooth alveolar morphology and cortical bone in the mandible (Farman & Scarfe, 2009). Patient radiation dose and scanning time are lower as compared to conventional medical CT, which reduces artifacts created by movement of the subject. In addition, CBCT measurements are generally precise in all dimensions because the voxels are isotropic, or uniform, in all planes. CBCT offers the advantages of accurate, reliable, and high definition images compared to conventional CT, MRI, and lateral cephalometric headfilms with a reduced radiation dose (Mah, Danforth, Bumann, & Hatcher, 2003). For all of the reasons cited above, CBCT technology has emerged as the superior imaging modality for the study of mandibular tooth-alveolar morphology in the different facial types.

Accuracy of CBCT Measurements of Cortical Bone

CBCT is an increasingly popular technology used in many specialties of dentistry because of its high performance, low cost, and reduced radiation dose compared with conventional computed tomography (Mah et al., 2003). Because CBCT is a relatively new advancement, numerous studies have been conducted to evaluate the accuracy of CBCT data. Initial studies conducted in 2004 comparing direct measurements with CBCT measurements on dry cadaver mandibles reveal that linear distance measurements are accurate with CBCT with a mean measurement error of only 0.22mm (±15) (Kobayashi, Shimoda, Nakagawa, & Yamodo, 2004). More recent studies have reported similar results with the exception that possible measurement inaccuracies can occur in areas of thin bone such as the mandibular anterior incisor region (Patcas, Muller, Ullrich, & Peltomaki, 2012). Research conducted in 2011 found only submillimetric differences in measurements of cadaver buccal bone height and buccal bone thickness of 0.30 and 0.13 mm, respectively, and concluded that CBCT imaging can provide accurate and reliable representations of buccal alveolar bone dimensions (Timock et al., 2011). This is consistent with the findings of another 2010 study where mean absolute measurement errors were 0.05mm and 0.07mm for the 0.25mm voxel-size scans and 0.4mm voxel-size scans, respectively (Damstra, Fourie, Huddleston, & Ren, 2010). A 2012 study also concluded that CBCT is an appropriate tool to use for linear intraoral measurements because accurate data is provided and anatomic structures are depicted reliably (Patcas et al., 2012). However, these researchers noted that in the areas of thin buccal bone in the mandibular anterior incisor region there is a risk of assuming fenestrations and dehiscence on CBCT radiographs that do not exist clinically. Another study found that when alveolar bone thickness is near or smaller than the

CBCT voxel size, alveolar bone height measurements are likely to be underestimated by 0.9 to 1.2mm (Sun et al., 2011).

Bone can become invisible in a CBCT image due to two factors: the partial volume averaging effect and contrast resolution (Sun et al., 2011). The partial volume averaging effect occurs when a voxel lies on two objects of different densities. This voxel reflects the average density of both objects rather than the true density of either object. Therefore when the thickness of the alveolar bone is below or near the voxel size the voxel will reflect an average density of the alveolar bone and periodontal ligament rather than the true density of the alveolar bone. Bone may be hard to distinguish from adjacent periodontal ligament structures when the thickness is below or at the voxel size and therefore not taken into account when measuring alveolar bone height (Sun et al., 2011).

Contrast resolution determines the ability to distinguish two objects of similar densities and in close proximity. The periodontal ligament (approximately 0.5mm thick) separates the alveolar bone from the cementum and anything smaller than this minimum distance requirement could result in the alveolar bone becoming indistinguishable from the cementum (Sun et al., 2011). Areas with bone less than 0.6mm thick were invisible on CBCT images (Leung et al., 2010).

CBCT can be reliably used in the current study of mandibular alveolar morphology of adolescents as the majority of measurements of cortical bone thickness and height are concentrated in the posterior mandible where there is greater cortical bone thickness. Results of past research have demonstrated that measurements of a few millimeters with CBCT are accurate and repeatable (Damstra et al., 2010; Kobayashi et al, 2004; Timock et al., 2011). The cortical bone measurements collected in this research project were generally 5 to 10 times greater than the 0.38 mm voxel-size scans used. In addition, recent research using study samples of fresh young pig heads with bone equivalent to that of early adolescent humans found that for 0.40 mm voxel-size scans, measurements in the mandibular molar regions were generally accurate (Wood et al, 2013). For the measurements of mandibular anterior incisors in this current investigation of adolescent mandibular morphology, measurements of cortical bone thickness were at 1/3rd and 2/3rd of alveolar bone height and not at the bone margin as used in past studies where cortical bone can be extremely thin (Leung et al., 2010; Patcas et al., 2012; Wood et al., 2013). Mandibular anterior cortical bone measurements collected in this study were generally 3 to 8 times that of the 0.38 mm voxel size, which decreased the chance of underestimation of cortical bone thickness. Alveolar bone height in the anterior incisor region may be underestimated, however, if the cortical bone thickness is at or below the voxel size. Therefore, the analysis of the results in this research project must address for this possible underestimation of alveolar bone height.

CT Studies of Mandibular Morphology and Facial Types

Facial types are important in orthodontics because they influence anchorage usage, growth prediction of maxillofacial structures, and goals of treatment. The significance of this relationship has prompted studies to investigate the relationship between vertical facial type and mandibular tooth alveolar morphology. Since CBCT was only introduced in Europe in the 1990s and in North America in 2001, CT was the main imaging modality used to obtain radiographic sections for measurement in the earlier studies of tooth-alveolar morphology as related to facial type.

In two studies, conducted in 1997 and 1998, researchers at the Department of Orthodontics at Nihon University School of Dentistry at Matsudo evaluated the cortical bone thickness, tooth inclination, and bone inclination of the mandible using CT scans of 40 dry skulls and 39 dry skulls of male Asiatic Indians, respectively, and correlated the findings with vertical facial patterns (Kohakura et al., 1997; Tsunori et. al, 1998). Both studies used a lateral radiograph of the skull for each specimen to determine the facial type. In addition, both studies used four CT scan sections of the mandibular body at the left lower incisor, left lower second premolar, left lower first molar, and left lower second molar for measurements of the cortical bone, tooth inclination, and bone inclination. Both studies found that the thickness of the buccal cortical bone strongly correlated with facial type. The buccal cortical bone of short-faced subjects was thicker than that of average or long-faced subjects for all sections measured in the 1998 study and only at the second premolar and first molar for the 1997 study. The 1998 study found that the lingual cortical bone in short-faced subjects in the first and second molar region was thicker than in other facial types but the 1997 study only found the same correlation with the second molar region. The 1998 study also found that the second premolar, first molar, and second molar were all more lingually inclined in the short-faced group, while the 1997 study only found a correlation with the second molars. The 1997 study found that the height at the second molar region was less than at the lower incisor region, while width was greater at the second molar region than at the lower incisor region in all facial types.

In 2001, researchers studied the CT scans of 31 dry skulls of modern Japanese males between the ages of 18 and 45 years with a mean average age of 27 years (Matsumoto et al., 2001). Similar to the results of the 1998 study by Tsunori et al., the cortical bone thickness of the first molar and second molar sections was thicker in short-faced subjects than in average and long-faced subjects. The lingual cortical bone was thicker in the short-faced patient in the lower third region of the mandible. However, contrary to the 1997 and 1998 studies, teeth of long-faced subjects were more lingually inclined than those of short-faced subjects (Kohakura et al., 1997, Tsunori et. al., 1998).

There is a consensus among the CT studies that buccal and lingual cortical bone thickness is generally greater in short-faced subjects although there are some slight differences reported regarding which regions have the thicker cortical bones (Kohakura et al., 1997, Matsumoto et al., 2001, Tsunori et. al., 1998). The main disparity in findings lies in whether the posterior mandibular teeth are more lingually inclined in the short-faced or long-faced group. The 2001 study found that teeth of long-faced subjects were more lingually inclined, while the 1997 and 1998 studies found that teeth of short-faced subjects were more lingually inclined (Kohakura et al., 1997; Matsumoto et al, 2001; Tsunori et. al., 1998).

CBCT Studies of Mandibular Morphology and Facial Types

The appearance of CBCT technology has opened new possibilities for dental and maxillofacial assessment and research. The improved imaging capability of the CBCT allows for more extensive and accurate investigation of mandibular morphology as related to facial form. Landmarks can be more precisely and easily identified, and additional measurements can be taken, due to the 3-D nature of the images (Mah, Huang, & Choo, 2010). Studies evaluating the relationships between mandibular tooth-alveolar morphology and facial types using CBCT have been conducted in the past few years, but these studies have been limited in number and in its scope especially pertaining to the mandibular morphology of adolescents.

The earlier CBCT studies evaluating facial types and mandibular morphology focused mainly on measurements of cortical bone thickness in the adult population with a mean age of 27 years in one 2012 study and an age range from 20 to 45 years in another 2013 study (Horner et al., 2012; Ozdemir et al., 2013). In these studies the digital communications in medicine

(DICOM) files of each CBCT scan were imported into three dimensional software and the images were oriented in three planes of space so that measurements could be made on a cross section of the alveolar bone at various sites in the mandible. Both studies found statistically significant differences between the facial types in the buccal cortical bone between the premolar, first molar, and second molar interradicular sites in the mandible. Statistically significant differences in the thickness of lingual cortical bone was found at two sites (Horner et al., 2012). These studies concluded that the hypodivergent group has thicker cortical bone at many sites in the mandible and thicker alveolar bone thickness in general than the hyperdivergent subjects (Horner et al., 2012; Ozdemir et al., 2013).

Researchers at the University of California at San Francisco in 2011 used CBCT technology to evaluate a larger age range of patients which included a total of 111 subjects between the ages of 10 and 65 years (Swasty et al., 2011). Although adolescents were included in the study, the investigation focused on the comparison of the mandibular cortical bone thickness, height, and width between the facial types only. Consistent with the findings of the 2012 and 2013 CBCT studies, the 2011 CBCT study found that subjects in the short-faced group had a thicker cortical plate in many regions of the buccal and lingual areas while subjects in the long-faced group had thinner cortical bone in almost all sites in the mandible (Horner et al., 2012; Ozdemir et al., 2013). In the long-faced group, there was a considerable change in height of the mandibular cross-sectional area from the molars to the symphysis with maximum change in height occurring around the incisors. The long-faced group also showed a statistically significant narrower cross section of the mandible in the upper third region compared with the average-face and short-faced groups. This is consistent with the findings of a 2014 CBCT study where the long-faced group was found to have the thinner alveolus and larger dentoalveolar height in the anterior mandible compared to the short face group (Sadek et al., 2014). This 2014 study reported that due to the thin alveolus there were significantly lower values for the maximum possible buccal lingual movements of the central and lateral incisors in the long-faced group.

A more comprehensive CBCT investigation of mandibular tooth alveolar morphology was performed by researchers in China in 2012 (Han et al., 2013). Cortical bone thickness, basal bone thickness, inclination of teeth, inclination of bone, and height and width of mandibular bone were all analyzed. Although this study of tooth alveolar morphology is more comprehensive than past CBCT studies, the analysis was restricted to 45 Chinese adult male and female subjects between the ages of 21 and 41 years. Consistent with findings from previous CT and CBCT research, average thickness of the buccal cortical bone was greater in patients with the horizontal growth pattern. This study found no statistical differences in the widths of the mandibular bone between the two facial groups, which differs from the 2011 and 2012 CBCT studies (Horner, et al., 2012; Swasty et al., 2011). This study also found that the first and second molars have a greater buccal inclination in short-faced patients when compared to those patients with a vertical growth pattern. This finding differs from the previous CT studies of mandibular morphology where greater molar buccal inclination was found in long-faced patients but agrees with the findings of the 2001 CT study (Kohakura et al., 1997; Matsumoto et al., 2001; Tsunori et al., 1998).

There is consensus among the CBCT and the CT studies that cortical bone thickness is greater in the hypodivergent facial type and thinner in the hyperdivergent facial type in adults (Han et al., 2013; Horner et al., 2012; Kohakura et al., 1997; Matsumoto et al., 2001; Ozdemir, et al., 2013; Swasty et al., 2011; Tsunori et. al., 1998). Studies have also concluded that there is a significant change in height of the mandibular alveolar bone with the maximum change in height occurring around the incisors in the long-faced type. The long-faced group has the larger anterior dentoalveolar height in the mandible and the thinner alveolus compared to the short-faced group (Han, 2012; Sadek et al., 2014; Swasty et al., 2011). However, there are differing conclusions on whether there are differences in the alveolar bone height, alveolar bone width, and tooth inclination between the three facial types. These differences in findings warrant additional research to provide further clarification on these topics. In addition, more studies investigating the tooth alveolar morphology of adolescents with different facial divergences should be conducted.

Chapter 3: Methodology

The following protocol, #1411-4992M, was reviewed by the Office of Research Integrity – Human Subjects at the University of Nevada, Las, Vegas, and deemed excluded from IRB review (Appendix A).

Subjects

A total of 561 CBCT scans were obtained from the UNLV School of Dental Medicine archival dental records from August 2006 to June 2014. All CBCT scans were taken by one radiology technician trained in the technique and operation of the CBCT (CB MercuRay, Hitachi Medical Corp). Scans were taken with a matrix of 512 x 512, 193 mm FOV, 100 kV, 15 mA, and exposure time of 10 seconds. The data was sent directly to a UNLV School of Dental Medicine computer with password protected access and stored in Digital Imaging and Communications in Medicine format (DICOM). Volumetric renderings of subjects' CBCT scans were evaluated with InvivoDental version 5.4.1 software (Anatomage, San Jose, CA).

Of the 561 total records, 173 (72 males, 101 females) subjects between the ages of 12 and 18 years were chosen for inclusion. Among these patients, 61 displayed the vertical growth pattern, 30 displayed the horizontal growth pattern, and 82 displayed the average growth pattern. CBCT scans were included only if they were of good image quality and were absent of any movement artifact. Subjects with complete dentition including full eruption of the second permanent molars, no remaining deciduous teeth, and symmetric mandibles were included. Subjects with missing or root canal treated teeth, large metallic restorations, mandibular pathology, deciduous or incomplete dentition, syndromes or disease that may affect craniofacial development, past history of mandibular surgery, or currently receiving orthodontic treatment were excluded. The age range of 12 to 18 years was chosen as second molars have generally erupted by the age of 12 and adolescence has been commonly defined as spanning the ages of 12 to 18 years (American Academy of Pediatrics, 2011; Dean, Avery, & McDonald, 2011). In addition, data collected can be compared with past CBCT investigations of cortical bone thickness in adolescents with the age range of 13 to 18 years (Fayed, Pazera, & Katsaros, 2010). Adolescents are the focus of this study as they consist of the main treatment population for orthodontics. Data collected were analyzed according to the following age groups:

Group 1: Age 12-18 (“12 to 18 Age Group”)
Group 2: Age 12-13 (“12 to 13 Age Group”)
Group 3: Age 14-15 (“14 to 15 Age Group”)
Group 4: Age 16-18 (“16 to 18 Age Group”)

The combined age group of 12 to 18 years was also studied and the results reported because of the limited sample sizes once the subjects were classified in their individual age sub-groups.

3-D volumetric skeletal tracings from these scans were used to determine the facial type for each subject. All images were reoriented so that the mandibular plane (Gonion-Menton) was parallel to the floor. Measurements were then made of the buccal cortical bone thickness, lingual cortical bone thickness, basal bone thickness, mandibular alveolar bone height, mandibular alveolar bone width, tooth inclination, and alveolar bone inclination in the cross sectional image at four locations in the mandible.

All personal information regarding the subjects was anonymized. Age, sex, and facial types for each individual were recorded independently and only made available for this project upon the completion of data collection.

Determination of Vertical Facial Type

The primary investigator performed 3-D volumetric skeletal tracings to classify subjects into the normodivergent, hyperdivergent, and hypodivergent facial types based on standard values (Table 3.1). The classifications of facial type was determined by the angular measurement Sella-Nasion and Gonion-Menton angle (SN-GoMe) and the linear Facial Height Index (FHI) measurement. Subjects had to fit into a single facial type category for both measurements in order to be included in the study.

1. **SN-GoMe** –the angle formed by the Sella Nasion plane (S-N) to the Gonion-Menton (Go-Me) plane (Figure 3.1)

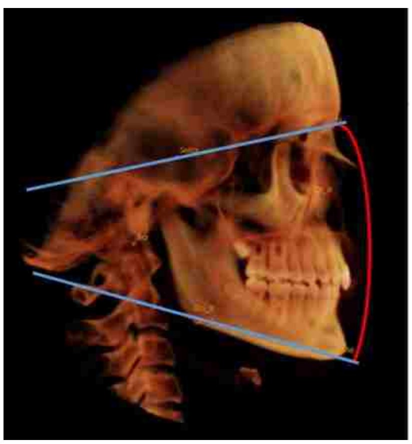

Figure 3.1. SN-GoMe Angle (red line)

2. **Facial Height index** –ratio of posterior facial height (PFH) to anterior facial height (AHF) or PFH/AFH

a. **AFH** –Anterior Facial Height is the linear distance between Nasion and Menton (Figure 3.2)

Figure 3.2. AFH (Blue Line)

b. **PFH** –Posterior Facial Height is the linear distance between Sella and Gonion (Figure 3.3)

Figure 3.3. PFH (Blue Line)

Table 3.1
Vertical Skeletal Measurement Norms

	SN-GoMe (°)*	FHI (%)*
Normodivergent	27-37	61-69
Hyperdivergent	> 37	<61
Hypodivergent	<27	>69

(Horn, 1992; Jacobson & Jacobson, 2006; Riedel, 1952)
*Consistent with the measurement norms and standard deviations in Invivo 5.4.1

Adjustment for Head Position

The cross-sections taken of the mandible for measurement purposes would differ depending on the mandibular plane angles of the subjects studied. Those who have a mandibular lower border that closely parallels the floor would have a shorter cross-section than those with a steeper mandibular plane. In order to correct for this factor, all subjects were reoriented so that the mandibular plane (Go-Me) was parallel to the floor (Figure 3.4). The reorientation was performed with the InVivo 5.4.1 software by defining a horizontal plane in the coordinate system in the "3D Analysis tab" and using gonion and menton as reference points.

Figure 3.4. Mandibular Plane (Go-Me) parallels the floor

Measurement of the Tooth alveolar complex

A total of four mandibular cross-sections (C1, P2, M1, and M2) were taken for each subject. C1 is the cross-section passing through the center of the lower right central incisor; P2 is the cross-section passing through the center of the lower right second premolar; M1 is the cross-section passing through the center of the mesial root of the lower right first molar; M2 is the cross-section passing through the center of the mesial root of the lower right second molar (Figure 3.5).

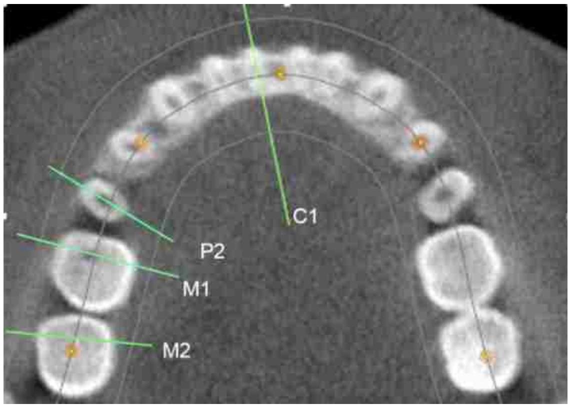

Figure 3.5. Cross Sections in the Occlusal View

Because previous studies reported that cortical bone width is the same for both sides of the jaw, only one side of the mandible was measured (Deguchi, Nsu, Yabuuch, & Takana-Yamamoto, 2006; Schwartz-Dabney & Dechow, 2003).

Measurements for each cross section was performed in the “Arch Section” tab of InVivo 5.4.1. Slice thickness was set at 1.0mm. For each cross section a total of 10 measurements were recorded. The cortical bone was measured at 5 sites: 2 buccal, 2 lingual, and 1 at the base. One height, 2 widths, 1 tooth inclination, and 1 bone inclination measurements were also recorded.

First, a length measurement was made by drawing a line perpendicular to the mandibular plane at the height of the alveolar crest to the mandibular plane. This length was then divided into equal vertical thirds. Two lines were then extended perpendicular to this length at 1/3rd and 2/3rds the height and these 2 lines served as reference points for the cortical bone thickness and width measurements (Figure 3.6). These measurement procedures followed the protocol used in the CBCT study by Swasty et al. (2011).

1. **Cortical bone thickness (a):** The 1/3rd and 2/3^{rds} reference lines were used to determine where the buccal and lingual cortical bone thicknesses were measured. Two measurements were taken of the buccal cortical bone and two measurements were taken

of the lingual cortical bone. The measurement lines were angled in the same direction that the cross-section was angled and positioned at approximately 90 degrees to the external surface of the cortical bone. This was done to prevent false readings taken obliquely through the cortical plate (Figure 3.6).

2. **Basal bone thickness (b):** 1 measurement was made at the base of the mandible (Figure 3.7).

3. **Alveolar bone height (c):** Height from the center of the alveolar bone crest to the inferior border of the mandible. Measurement was drawn along the long axis of the section and placed approximately through the center of the slice (Figure 3.8).

4. **Alveolar bone width (d):** Width of the mandibular cross section taken at 2 sites, using the same $1/3^{rd}$ and $2/3^{rds}$ reference lines used in measuring the thickness of the cortical plates. Widths were recorded perpendicular to the height measurement that was taken through the long axis (Figure 3.9).

5. **Tooth inclination (e):** The angle between the basal line (mandibular plane) and the tooth long axis. The long axis of the tooth is defined as the line passing through the mid-point of crown width and the root apex (Figure 3.10).

6. **Bone inclination (f):** The angle between the basal line (mandibular plane) and the bone axis. The long axis of the bone is defined as the line passing through the middle point of the buccal and lingual alveolar process and the inferior border of the mandible (Figure 3.11).

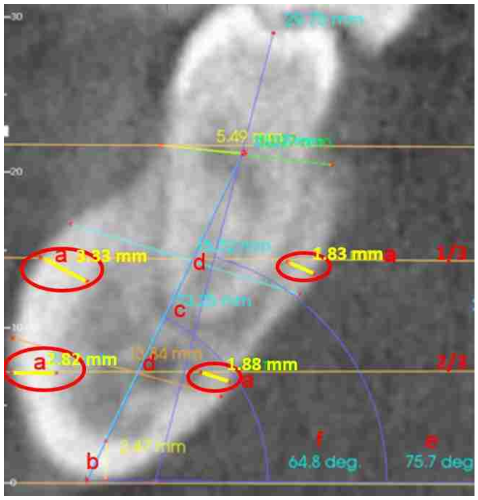

Figure 3.6. Measurement of Buccal and Lingual Cortical bone (a)

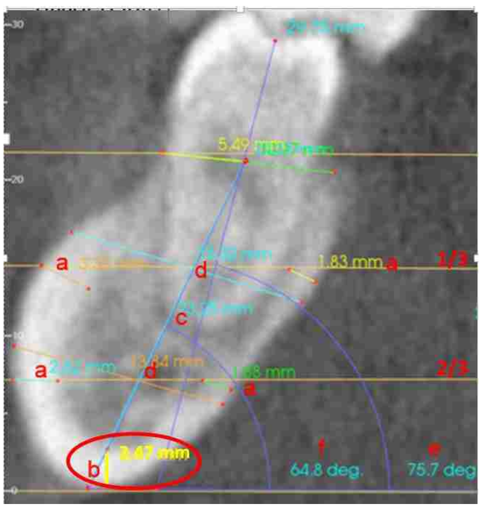

Figure 3.7. Measurement of Basal Bone (b)

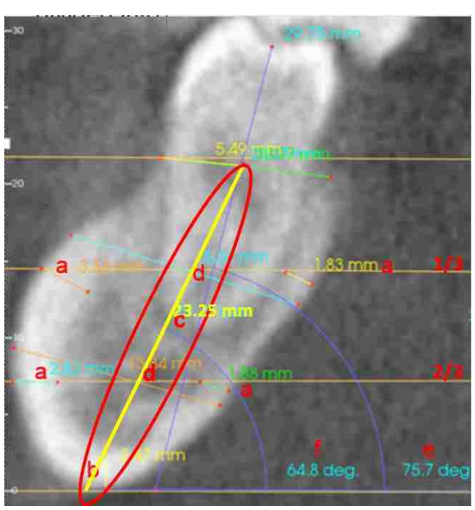

Figure 3.8. Measurement of Alveolar Bone Height (c)

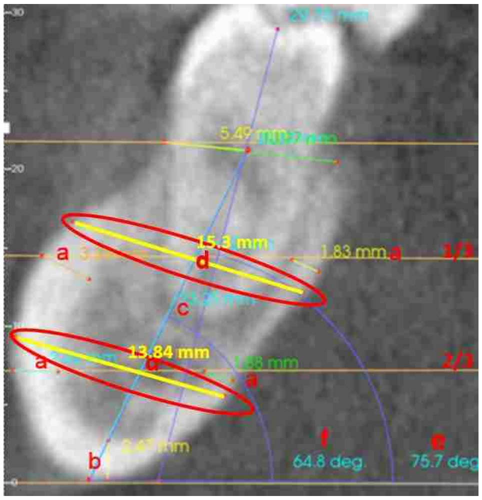

Figure 3.9 Measurement of Alveolar Bone Width (d)

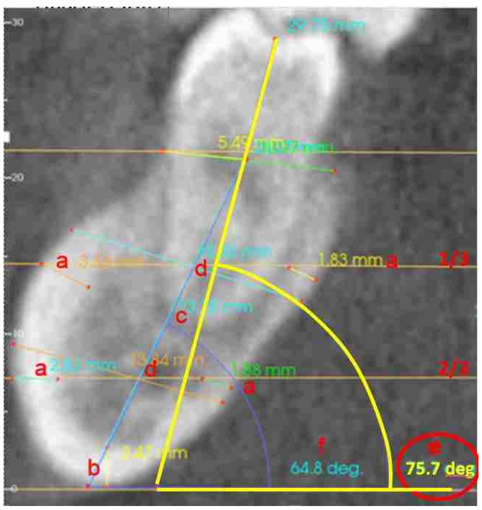

Figure 3.10. Measurement of the Tooth Inclination (e)

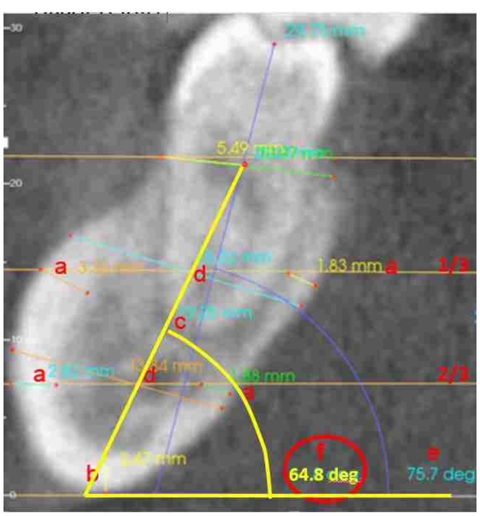

Figure 3.11. Measurement of the Alveolar Bone Inclination (f)

Table 3.2

Abbreviations Used To Indicate Measurement Sites

Second Molar	
CBB132M	Second Molar Buccal Cortical Bone at 1/3rd Height
CBB232M	Second Molar Buccal Cortical Bone at 2/3rds Height
CLB132M	Second Molar Lingual Cortical Bone at 1/3rd Height
CLB232M	Second Molar Lingual Cortical Bone at 2/3rds Height
BB2M	Second Molar Basal Bone
BHT2M	Second Molar Alveolar Bone Height
BW132M	Second Molar Bone Width at 1/3rd Height
BW232M	Second Molar Bone Width at 2/3rds Height
TIncl2M	Second Molar Tooth Inclination
BIncl2M	Second Molar Bone Inclination
First Molar	
CBB131M	First Molar Buccal Cortical Bone at 1/3rd Height
CBB231M	First Molar Buccal Cortical Bone at 2/3rds Height
CLB131M	First Molar Lingual Cortical Bone at 1/3rd Height
CLB231M	First Molar Lingual Cortical Bone at 2/3rds Height
BB1M	First Molar Basal Bone
BHT1M	First Molar Alveolar Bone Height
BW131M	First Molar Bone Width at 1/3rd Height
BW231M	First Molar Bone Width at 2/3rds Height
TIncl1M	First Molar Tooth Inclination
BIncl1M	First Molar Bone Inclination
Second Premolar	
CBB132P	Second Premolar Buccal Cortical Bone at 1/3rd Height
CBB232P	Second Premolar Buccal Cortical Bone at 2/3rds Height
CLB132P	Second Premolar Lingual Cortical Bone at 1/3rd Height
CLB232P	Second Premolar Lingual Cortical Bone at 2/3rds Height
BB2P	Second Premolar Basal Bone
BHT2P	Second Premolar Alveolar Bone Height
BW132P	Second Premolar Bone Width at 1/3rd Height
BW232P	Second Premolar Bone Width at 2/3rds Height
TIncl2P	Second Premolar Tooth Inclination
BIncl2P	Second Premolar Bone Inclination
Central Incisor	
CBB13CI	Central Incisor Buccal Cortical Bone at 1/3rd Height
CBB23CI	Central Incisor Buccal Cortical Bone at 2/3rds Height
CLB13CI	Central Incisor Lingual Cortical Bone at 1/3rd Height
CLB23CI	Central Incisor Lingual Cortical Bone at 2/3rds Height

Table 3.2 (Continued)

Abbreviations Used To Indicate Measurement Sites

Central Incisor	
BBCI	Central Incisor Basal Bone
BHTCI	Central Incisor Alveolar Bone Height
BW13CI	Central Incisor Bone Width at 1/3rd Height
BW23CI	Central Incisor Bone Width at 2/3rds Height
TInclCI	Central Incisor Tooth Inclination
BInclCI	Central Incisor Bone Inclination

Statistics

The intra-operator error was obtained by repeating measurements on 10 randomly selected subjects three months after the initial measurements. The degree of reliability was determined using Lin's concordance correlation.

Data from Excel was transferred into SPSS software version 23.0 (SPSS, Chicago, IL) for statistical analysis. A test of normality using Shapiro-Wilks test and a test of homogeneity of variances using Levene's test were conducted to ensure the assumptions of the one way ANOVA were met (Appendix B). Statistical analysis among the facial groups was performed using a separate analysis of variance (ANOVA) for each measurement location with post-hoc Scheffé analysis with a significance level of $p < 0.05$ (Appendix C). Mean and standard deviation were calculated to evaluate the measurement variables between the different facial types.

Chapter 4: Results

Age Distribution

The age distribution of the 173 individuals evaluated in this study ranged from 12 to 18 years. The subjects were divided into 4 age groups with 1 group encompassing the entire age range of 12 to 18 years. Table 4.1 shows the breakdown of the age groups and the gender distribution. Table 4.2 shows the breakdown of the age groups and the facial type distribution.

Table 4.1

Sample Distribution of each Age Group According to Gender

Group	Age	Gender	Sample Size	Total Sample
1	12-18	Male	72	173
		Female	101	
2	12-13	Male	23	65
		Female	42	
3	14-15	Male	34	75
		Female	41	
4	16-18	Male	15	33
		Female	18	

Table 4.2

Sample Distribution of Each Age Group According to Facial Type

Group	Age	Facial Type	Sample Size	Total Sample Size
1	12-18	Normodivergent	82	173
		Hypodivergent	30	
		Hyperdivergent	61	
2	12-13	Normodivergent	35	65
		Hypodivergent	11	
		Hyperdivergent	19	
3	14-15	Normodivergent	38	75
		Hypodivergent	12	
		Hyperdivergent	25	
4	16-18	Normodivergent	9	33
		Hypodivergent	7	
		Hyperdivergent	17	

Intra-Observer Error

In order to test the degree of reliability for the methods used in this study, intra-observer error testing was carried out on 10 (5 females, 5 males) randomly selected individuals. A Lin's concordance correlation was carried out to compare the results of the original and secondary measurements for each location in the mandible (Table 4.3). A score of 1 indicated a perfect correlation, whereas 0 indicated no correlation at all. The Lin's concordance correlation score of the 10 subjects was 0.998, which indicates excellent repeatability using the InVivo 5.4.1 software with a single examiner.

Table 4.3

Analysis of Intra-Observer Error

Lin's Concordance Coefficient	Rc	Cb	Mn. Shift
	.998	1.000	.001
95% CI for Rc	Lower	Upper	
	.998	.999	
X & Y Statistics	Var1	Var2	
Mean	21.917	21.957	
Variance	884.835	895.326	
Association Statistics	Cov.	R	
	888.4795	.9982	
Fisher Transformation	Z	SE (Z)	
	3.506	.049	

Research Question 1

Is there a difference in the mandibular buccal cortical bone thickness between adolescents with normodivergent, hypodivergent, and hyperdivergent facial types? **Hypothesis:** There is a difference in the mandibular buccal cortical bone thickness between adolescents with normodivergent, hypodivergent, and hyperdivergent facial types. **Null Hypothesis:** There is no difference in the mandibular buccal cortical bone thickness between adolescents with normodivergent, hypodivergent, and hyperdivergent facial types. The null hypothesis was rejected. ANOVA and Post-Hoc Scheffé analysis (Appendix C) were conducted and statistically significant differences were found in mean buccal cortical bone thickness between facial types in all age groups (Table 4.4 and Table 4.5).

Age Group 12 to 18 Years

Statistically significant differences were found between the facial types at 8 out of 8 buccal cortical bone measurement sites in the mandible for the 12 to 18 age group. This includes the second molar upper and lower buccal sites at CBB132M ($p < .001$) and CBB232M ($p < .001$), the first molar upper and lower buccal sites at CBB131M ($p < .001$) and CBB231M ($p < .001$), the second premolar upper and lower buccal sites at CBB132P ($p < .001$) and CBB232P ($p < .001$), and the central incisor upper and lower buccal sites at CBB13CI ($p < .001$) and CBB23CI ($p = .001$) (Table 4.4). In addition, the buccal cortical bone thickness for the hypodivergent facial type was consistently greater at all sites measured compared with the normodivergent and hyperdivergent facial types. The normodivergent facial type had consistently greater buccal cortical bone thickness than the hyperdivergent facial type at all sites measured except at the second molar lower buccal site (Figure 4.1). In addition, the buccal cortical bone thickness decreased successively from the posterior region of the mandible to the anterior region in all facial types. Mean thicknesses ranged from 2.99mm (±0.52) at the second molar region to 1.96mm (±0.36) at the central incisor region for the hypodivergent group. Mean thicknesses ranged from 2.59mm (±0.49) at the second molar region to 1.78mm (±0.36) at the central incisor for the normodivergent group. Mean thicknesses ranged from 2.39mm (±0.45) at the second molar region to 1.66mm (±0.37) at the central incisor region for the hyperdivergent group (Table 4.4).

Table 4.4

Means and Standard Deviations of Buccal Cortical Bone Thickness

	Hypo		Norm		Hyper		Norm vs Hypo vs Hyper p < 0.05
	Mean (mm)	SD	Mean (mm)	SD	Mean (mm)	SD	
Age Group 12-18							
CBB132M	2.99	0.52	2.59	0.49	2.39	0.45	.000*
CBB232M	2.52	0.42	2.13	0.43	2.17	0.51	.000*
CBB131M	2.86	0.44	2.30	0.47	2.09	0.46	.000*
CBB231M	2.41	0.44	2.00	0.34	1.90	0.45	.000*
CBB132P	2.37	0.44	1.92	0.32	1.71	0.38	.000*
CBB232P	2.24	0.36	1.94	0.28	1.80	0.37	.000*
CBB13CI	1.76	0.34	1.39	0.29	1.27	0.27	.000*
CBB23CI	1.96	0.36	1.78	0.36	1.66	0.37	.001*

Note. *p < .05

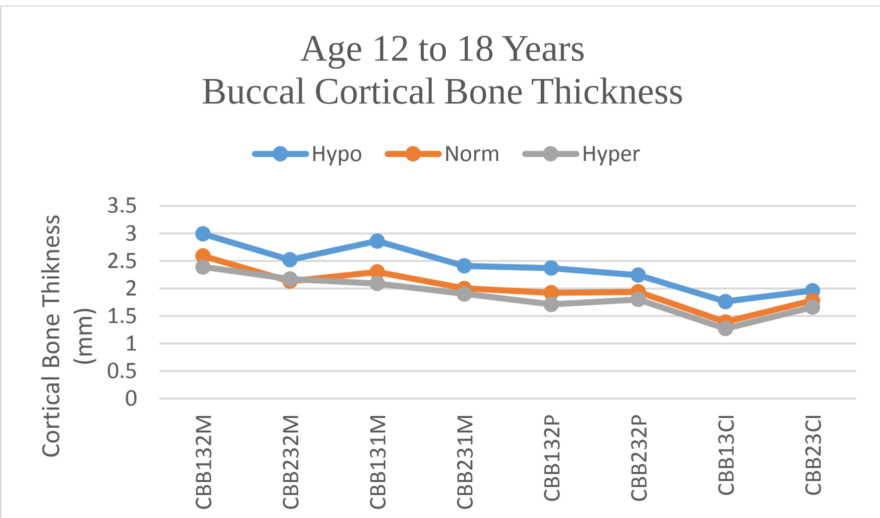

Figure 4.1. Buccal Cortical Bone Thickness for All Facial Types Age 12 to 18 Years

Age Groups Subdivided

Age Group 12 to 13 Years

Statistically significant differences were found between the facial types at 7 out of 8 buccal cortical bone measurement sites in the mandible for the 12 to 13 age group. This includes the second molar upper buccal site at CBB132M ($p = .003$), the first molar upper and lower buccal site at CBB131M ($p < .001$) and CBB231M ($p = .002$), the second premolar upper and lower buccal site at CBB132P ($p < .001$) and CBB232P ($p < .001$), and the central incisor upper and lower buccal site at CBB13CI ($p = .001$) and CBB23CI ($p = .021$) (Table 4.5). The only site that did not have statistically significant difference between the facial types was at the second molar lower buccal site CBB232M ($p = .087$). In addition, the buccal cortical bone thickness for the hypodivergent facial type was consistently greater at all sites measured compared with the normodivergent and hyperdivergent facial types. The normodivergent facial type had consistently greater buccal cortical bone thickness than the hyperdivergent facial type at all sites measured (Figure 4.2). In addition, the cortical bone thickness decreased successively from the posterior region to the anterior region of the mandible in all facial types.

Age Group 14 to 15 Years

Statistically significant differences were found between the facial types at 8 out of 8 buccal cortical bone measurement sites in the mandible for the 14 to 15 age group. This includes the second molar upper and lower buccal sites at CBB132M ($p < .001$) and CBB232M ($p = .007$), the first molar upper and lower buccal sites at CBB131M ($p < .001$) and CBB231M ($p = .001$), the second premolar upper and lower buccal sites at CBB132P ($p < .001$) and CBB232P ($p < .001$), and the central incisor upper and lower buccal sites at CBB13CI ($p < .001$) and CBB23CI (p =

.006) (Table 4.5). In addition, the buccal cortical bone thickness for the hypodivergent facial type was consistently greater at all sites measured than the normodivergent and hyperdivergent facial type. The normodivergent facial type had consistently greater buccal cortical bone thickness than the hyperdivergent facial type at all sites measured (Figure 4.3). In addition, the cortical bone thickness decreased successively from the posterior region of the mandible to the anterior region in all facial types.

Age Group 16 to 18 Years

Statistically significant differences were found between the facial types at 4 out of 8 buccal cortical bone measurement sites in the mandible for the 16 to 18 age group. This includes the first molar upper and lower buccal sites at CBB131M ($p = .001$) and CBB231M ($p = .049$), the second premolar upper buccal site at CBB132P ($p = .009$), and the central incisor upper buccal site at CBB13CI ($p = .014$) (Table 4.5). Measurement sites that were not statistically different include the second molar upper and lower buccal sites at CBB132M ($p = .077$) and CBB232M ($p = .389$), the second premolar lower buccal site at CBB232P ($p = .128$), and the central incisor lower buccal site at CBB23CI ($p = .977$). In addition, the buccal cortical bone thickness for the hypodivergent facial type was consistently greater at all sites measured compared with the normodivergent and hyperdivergent facial types. The normodivergent facial type had similar buccal cortical bone thickness to the hyperdivergent facial type (Figure 4.4). In addition, the cortical bone thickness decreased successively from the posterior region of the mandible to the anterior region in all facial types.

Table 4.5

Means and Standard Deviations of Buccal Cortical Bone Thickness

	Hypo		Norm		Hyper		Norm vs Hypo vs Hyper p < 0.05
	Mean (mm)	SD	Mean (mm)	SD	Mean (mm)	SD	
Age Group 12-13							
CBB132M	2.86	0.50	2.46	0.51	2.18	0.48	.003*
CBB232M	2.44	0.40	2.10	0.46	2.08	0.52	.087
CBB131M	2.77	0.48	2.22	0.42	2.04	0.46	.000*
CBB231M	2.35	0.42	1.97	0.33	1.82	0.41	.002*
CBB132P	2.42	0.48	1.89	0.30	1.70	0.43	.000*
CBB232P	2.29	0.41	1.90	0.28	1.75	0.41	.000*
CBB13CI	1.75	0.36	1.43	0.31	1.30	0.26	.001*
CBB23CI	1.95	0.40	1.70	0.30	1.59	0.36	.021*
Age Group 14-15							
CBB132M	2.99	0.48	2.65	0.44	2.35	0.37	.000*
CBB232M	2.59	0.46	2.16	0.42	2.13	0.44	.007*
CBB131M	2.81	0.46	2.41	0.47	2.03	0.37	.000*
CBB231M	2.44	0.50	2.06	0.35	1.91	0.39	.001*
CBB132P	2.36	0.47	1.94	0.32	1.70	0.33	.000*
CBB232P	2.23	0.40	2.02	0.26	1.81	0.28	.000*
CBB13CI	1.81	0.30	1.40	0.26	1.23	0.22	.000*
CBB23CI	2.05	0.34	1.85	0.39	1.63	0.36	.006*
Age Group 16-18							
CBB132M	3.19	0.62	2.82	0.53	2.68	0.40	.077
CBB232M	2.54	0.40	2.18	0.42	2.33	0.58	.389
CBB131M	3.09	0.30	2.08	0.55	2.22	0.58	.001*
CBB231M	2.44	0.42	1.85	0.30	1.98	0.57	.049*
CBB132P	2.32	0.37	1.94	0.40	1.73	0.41	.009*
CBB232P	2.16	0.25	1.80	0.31	1.84	0.45	.128
CBB13CI	1.69	0.43	1.18	0.23	1.29	0.35	.014*
CBB23CI	1.80	0.31	1.79	0.42	1.77	0.38	.977

Note. *p < .05

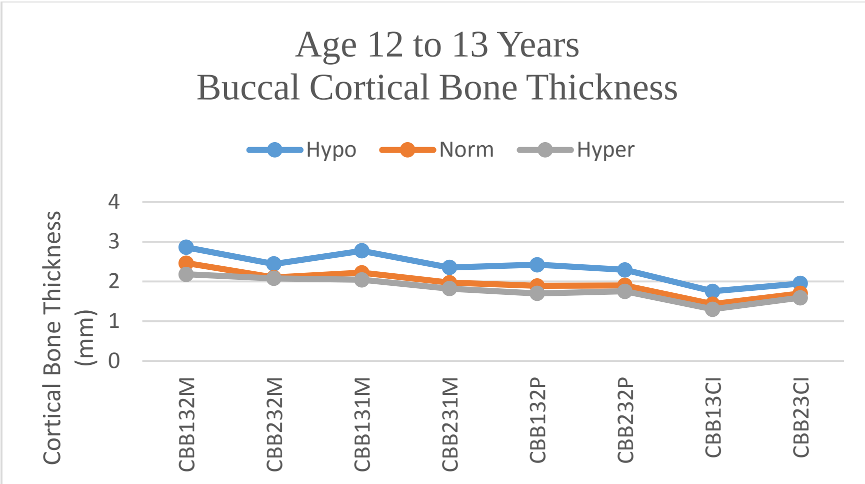

Figure 4.2. Buccal Cortical Bone Thickness for All Facial Types Age 12 to 13 Years

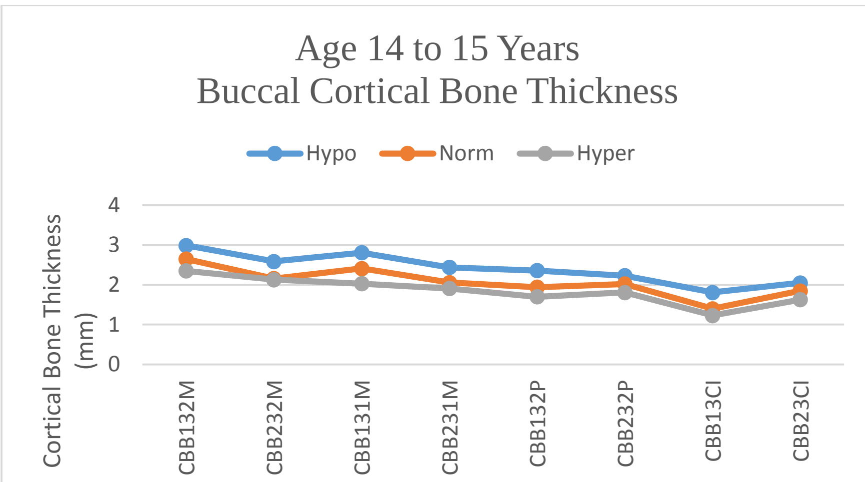

Figure 4.3. Buccal Cortical Bone Thickness for All Facial Types Age 14 to 15 Years

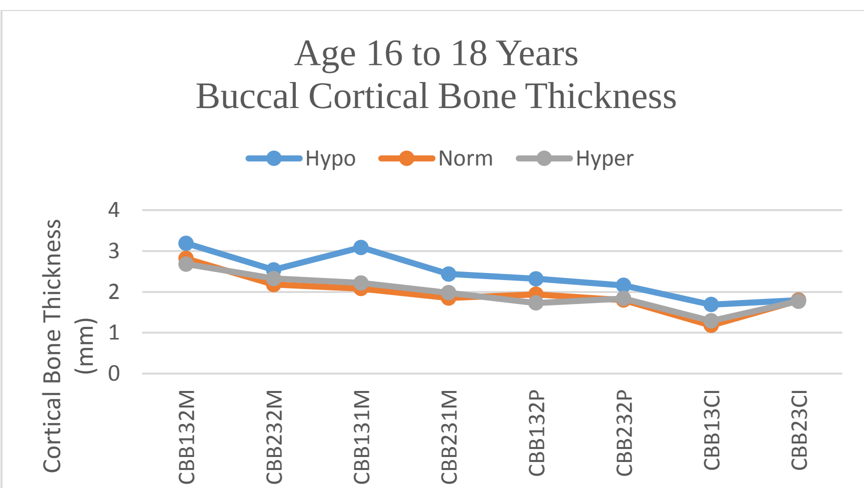

Figure 4.4. Buccal Cortical Bone Thickness for All Facial Types Age 16 to 18 Years

Research Question 2

Is there a difference in the mandibular lingual cortical bone thickness between adolescents with normodivergent, hypodivergent, and hyperdivergent facial types? **Hypothesis:** There is a difference in the mandibular lingual cortical bone thickness between adolescents with normodivergent, hypodivergent, and hyperdivergent facial types. **Null Hypothesis:** There is no difference in the mandibular lingual cortical bone thickness between adolescents with normodivergent, hypodivergent, and hyperdivergent facial types. The null hypothesis was rejected. ANOVA and Post-Hoc Scheffé analysis (Appendix C) were conducted and statistically significant differences were found in the mean lingual cortical bone thickness between the facial types in all age groups (Table 4.6 and Table 4.7).

Age Group 12 to 18 Years

Statistically significant differences were found between the facial types at 8 out of 8 sites measured in the mandible for the 12 to 18 age group including the second molar upper and lower lingual sites at CLB132M ($p < .001$) and CLB232M ($p < .001$), the first molar upper and lower lingual sites at CLB131M ($p < .001$) and CLB231M ($p < .001$), the second premolar upper and lower lingual sites at CLB132P ($p < .001$) and CLB232P ($p < .001$), and the central incisor upper and lower lingual sites at CLB13CI ($p < .001$) and CLB23CI ($p < .001$) (Table 4.6). In addition, the lingual cortical bone thickness for the hypodivergent facial type was consistently greater at all sites measured than the normodivergent and hyperdivergent facial types. The normodivergent facial type had greater lingual cortical bone thickness than the hyperdivergent facial type at all sites measured (Figure 4.5). In addition, the lingual cortical bone thickness was greater at 1/3rd height of the alveolar bone than at 2/3^{rds} height of the alveolar bone at all locations of measurement and in all facial types except at the central incisor. At the central incisor the lingual cortical bone was thicker at 2/3rds of the alveolar bone height rather than at 1/3rd of the alveolar bone height.

Table 4.6

Means and Standard Deviations of Lingual Cortical Bone Thickness

	Hypo		Norm		Hyper		Norm vs Hypo vs Hyper p < 0.05
	Mean (mm)	SD	Mean (mm)	SD	Mean (mm)	SD	
Age Group 12-18							
CLB132M	2.17	.53	1.84	.39	1.58	.40	.000*
CLB232M	1.82	.40	1.50	.36	1.38	.33	.000*
CLB231M	1.90	.46	1.64	.35	1.47	.34	.000*
CLB131M	2.73	.50	2.21	.50	2.03	.51	.000*
CLB132P	2.52	.38	2.13	.42	2.02	.48	.000*
CLB232P	2.01	.47	1.74	.34	1.61	.36	.000*
CLB13CI	2.06	.44	1.84	.34	1.67	.42	.000*
CLB23CI	3.50	.81	2.91	.71	2.70	.76	.000*

Note. *p < .05

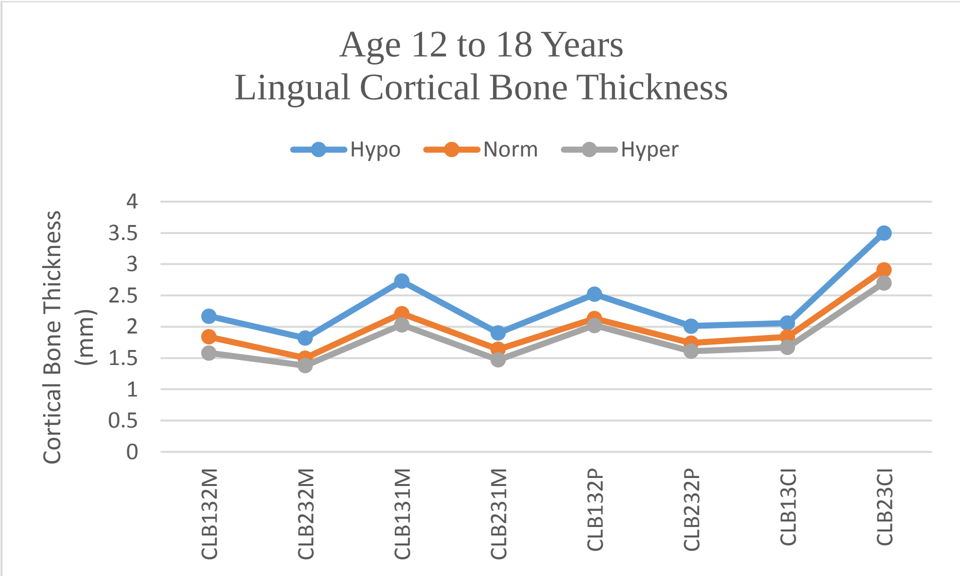

Figure 4.5. Lingual Cortical Bone Thickness for All Facial Types Age 12 to 18 Year

Age Groups Subdivided

Age Group 12 to 13 Years

Statistically significant differences were found between the facial types at 5 out of 8 sites measured in the mandible for the 12 to 13 age group. The statistically significant sites included the second molar upper lingual site at CLB132M (p = .003), the first molar upper and lower lingual sites at CLB131M (p = .008) and CLB231M (p = .026), the second premolar upper lingual site at CLB132P (p = .001), and the central incisor upper lingual site at CLB13CI (p = .003) (Table 4.7). The three sites that did not have statistically significant differences between the facial types was at the second molar lower lingual site at CLB232M (p = .286), the second premolar lower lingual site at CLB232P (p = .167), and the central incisor lower lingual site at CLB23CI (p = .350). In addition, the lingual cortical bone thickness for the hypodivergent facial type was consistently greater at all sites measured than the normodivergent and hyperdivergent facial types. The normodivergent facial type had greater lingual cortical bone thickness than the hyperdivergent facial type in the posterior region of the mandible but not at all sites in the anterior region (Figure 4.6). In addition, the lingual cortical bone thickness was greater at 1/3rd height of the alveolar bone than at 2/3^{rds} height of the alveolar bone at all locations of measurement and in all facial types except at the central incisor. At the central incisor the lingual cortical bone was thicker at 2/3^{rds} of the alveolar bone height rather than at 1/3rd of the alveolar bone height.

Age Group 14 to 15 Years

Statistically significant differences were found between the facial types at 8 out of 8 sites measured in the mandible for the 14 to 15 age group including the second molar upper and lower lingual site at CLB132M ($p = .001$) and CLB232M ($p < .001$), the first molar upper and lower lingual sites at CLB131M ($p = .001$) and CLB231M ($p = .002$), the second premolar upper and lower lingual sites at CLB132P ($p = .018$) and CLB232P ($p = .001$), and the central incisor upper and lower lingual sites at CLB13CI ($p = .002$) and CLB23CI ($p = .002$) (Table 4.7). In addition, the lingual cortical bone thickness for the hypodivergent facial type was consistently greater at all sites measured than the normodivergent and hyperdivergent facial types. The normodivergent facial type had greater lingual cortical bone thickness than the hyperdivergent facial type at all sites measured (Figure 4.7). In addition, the lingual cortical bone thickness was greater at $1/3^{rd}$ height of the alveolar bone than at $2/3^{rds}$ height of the alveolar bone at all locations of measurement and in all facial types except at the central incisor. At the central incisor the lingual cortical bone was thicker at $2/3^{rds}$ of the alveolar bone height rather than at $1/3^{rd}$ of the alveolar bone height.

Age Group 16 to 18 Years

Statistically significant differences were found between the facial types at 6 out of 8 sites measured in the mandible for the 16 to 18 age group including the second molar upper and lower lingual sites at CLB132M ($p = .004$) and CLB232M ($p = .001$), the first molar upper and lower lingual sites at CLB131M ($p = .004$) and CLB231M, ($p = .038$), the second premolar lower lingual site at CLB232P ($p = .028$), and the central incisor lower lingual site at CLB23CI ($p = .004$) (Table 4.7). The two sites that were not statistically significant between the facial types were at the second premolar upper lingual site at CLB132P ($p = .101$) and central incisor upper lingual site at

CLB13CI ($p = .653$). In addition, the lingual cortical bone thickness for the hypodivergent facial type was consistently greater at all sites measured than the normodivergent and hyperdivergent facial type. The normodivergent facial type had greater lingual cortical bone thickness than the hyperdivergent facial type at all sites measured (Figure 4.8). In addition, the lingual cortical bone thickness was greater at $1/3^{rd}$ height of the alveolar bone than at $2/3^{rds}$ height of the alveolar bone at all locations of measurement and in all facial types except at the central incisor. At the central incisor the lingual cortical bone was thicker at $2/3^{rds}$ of the alveolar bone height rather than at $1/3^{rd}$ of the alveolar bone height.

Table 4.7

Means and Standard Deviation of Lingual Cortical Bone Thickness

	Hypo		Norm		Hyper		Norm vs Hypo vs Hyper p < 0.05
	Mean (mm)	SD	Mean (mm)	SD	Mean (mm)	SD	
Age Group 12-13							
CLB132M	2.03	.41	1.76	.39	1.53	.32	.003*
CLB232M	1.58	.33	1.48	.32	1.38	.36	.286
CLB131M	2.54	.53	2.13	.52	1.93	.44	.008*
CLB231M	1.82	.49	1.63	.35	1.45	.29	.026*
CLB132P	2.56	.31	2.04	.46	1.92	.45	.001*
CLB232P	1.89	.61	1.67	.24	1.69	.28	.167
CLB13CI	2.14	.48	1.76	.35	1.67	.30	.003*
CLB23CI	3.09	.44	2.75	.69	2.76	.82	.350
Age Group 14-15							
CLB132M	2.13	.65	1.88	.36	1.56	.39	.001*
CLB232M	1.93	.38	1.51	.41	1.34	.32	.000*
CLB131M	2.75	.45	2.30	.47	2.06	.50	.001*
CLB231M	1.90	.38	1.66	.37	1.44	.32	.002*
CLB132P	2.46	.49	2.19	.41	2.00	.48	.018*
CLB232P	2.10	.38	1.84	.40	1.57	.42	.001*
CLB13CI	2.07	.40	1.90	.33	1.61	.46	.002*
CLB23CI	3.72	.92	3.04	.69	2.70	.85	.002*
Age Group 16-18							
CLB132M	2.43	.43	1.96	.46	1.65	.49	.004*
CLB232M	2.02	.38	1.51	.32	1.42	.31	.001*
CLB131M	2.98	.46	2.14	.49	2.12	.60	.004*
CLB231M	2.03	.59	1.58	.26	1.53	.42	.038*
CLB132P	2.57	.30	2.21	.31	2.15	.52	.101
CLB232P	2.03	.37	1.62	.30	1.59	.37	.028*
CLB13CI	1.92	.46	1.90	.32	1.77	.47	.653
CLB23CI	3.76	.93	2.95	.80	2.63	.53	.004*

Note. *p < .05

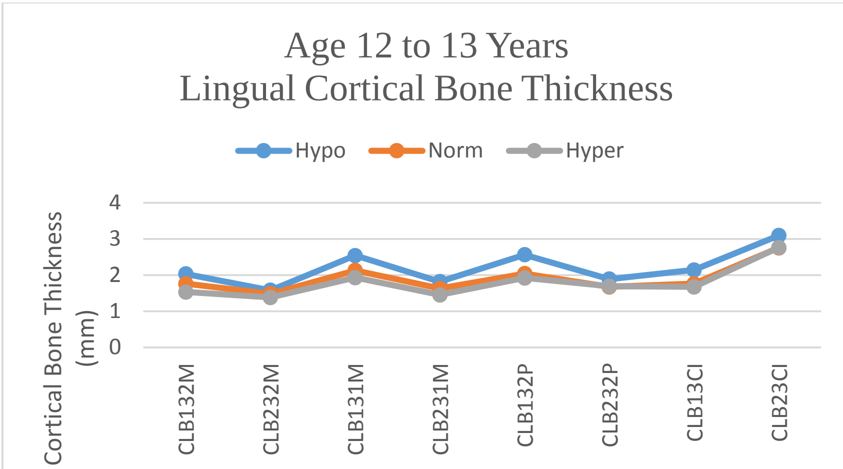

Figure 4.6. Lingual Cortical Bone Thickness for All Facial Types Age 12 to 13 Years

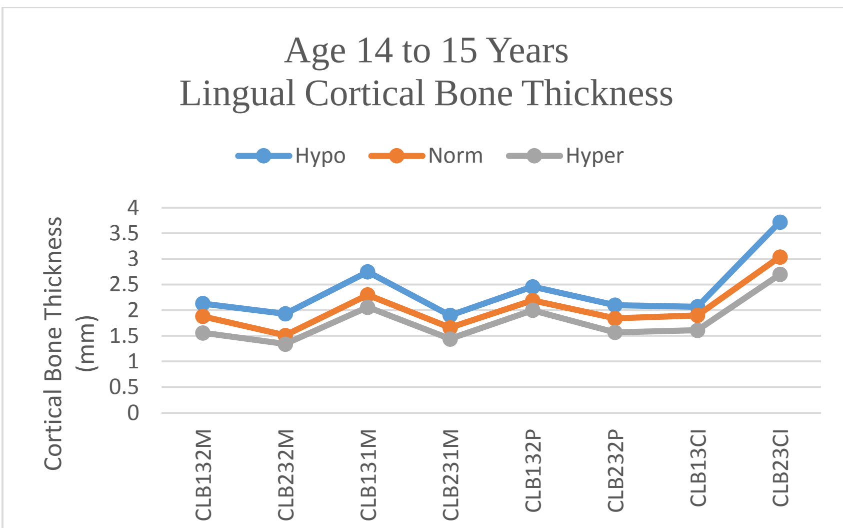

Figure 4.7. Lingual Cortical Bone Thickness for All Facial Types Age 14 to 15 Years

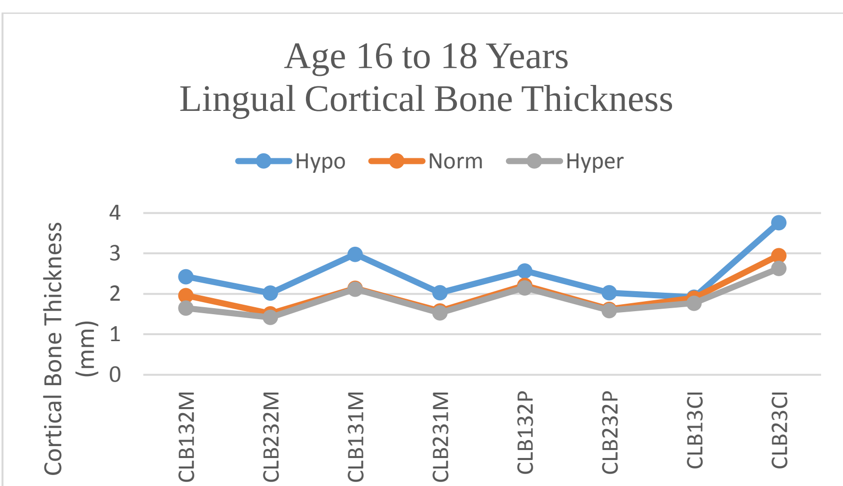

Figure 4.8. Lingual Cortical Bone Thickness for All Facial Types Age 16 to 18 Year

Research Question 3

Is there a difference in the mandibular alveolar bone height between adolescents with normodivergent, hypodivergent, and hyperdivergent facial types? **Hypothesis**: There is a difference in the mandibular alveolar bone height between adolescents with normodivergent, hypodivergent, and hyperdivergent facial types. **Null Hypothesis**: There is no difference in the mandibular alveolar bone height between adolescents with normodivergent, hypodivergent, and hyperdivergent facial types. The null hypothesis was rejected. ANOVA and Post-Hoc Scheffé analysis (Appendix C) were conducted and statistically significant differences were found in mean alveolar bone height between the facial types in all age groups (Table 4.8 and Table 4.9).

Age Group 12 to 18 Years

Statistically significant differences in alveolar bone height were found between the facial types at the central incisor at BHTCI ($p < .001$) and at the second molar at BHT2M ($p = .021$) for the 12 to 18 age group. No statistically significant differences were found at the first molar or second premolar measurement sites between the facial types (Table 4.8). Bone height successively increased from the posterior region of the mandible to the anterior region of the mandible in all facial types (Figure 4.9). Mean alveolar bone heights ranged from 23.66mm (±2.42) at the second molar region to 27.33mm (±2.99) at the central incisor region for the hypodivergent group. Mean alveolar bone height ranged from 23.11mm (±2.05) at the second molar region to 28.30mm (±3.00) at the central incisor region for the normodivergent group. Mean alveolar bone height ranged from 22.39mm (±2.12) at the second molar region to 30.79mm (±3.16) at the central incisor region for the hyperdivergent group (Table 4.8). The hyperdivergent facial type had the greatest alveolar bone height compared with the other facial types at the central incisor region and the shortest alveolar bone height at the second molar region (Figure 4.9). The hypodivergent facial type had the greatest alveolar bone height at the second molar region and the shortest alveolar bone height at the central incisor region.

Table 4.8

Means and Standard Deviations of Alveolar Bone Height

	Hypo		Norm		Hyper		Norm vs Hypo vs Hyper p < 0.05
	Mean (mm)	SD	Mean (mm)	SD	Mean (mm)	SD	
Age Group 12-18							
BHT2M	23.66	2.42	23.11	2.05	22.39	2.12	.021*
BHT1M	25.33	3.06	25.12	2.36	25.41	2.66	.794
BHT2P	26.34	3.39	26.40	2.56	27.24	2.70	.156
BHTCI	27.33	2.99	28.30	3.00	30.79	3.16	.000*

Note. *p < .05

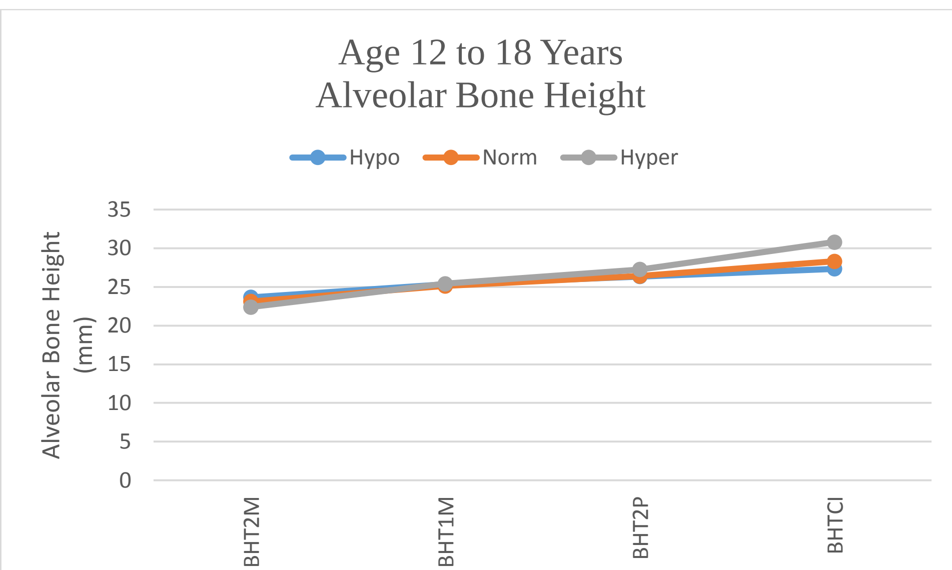

Figure 4.9. Alveolar Bone Height for All Facial Types Age 12 to 18 Years

Age Groups Subdivided

Age Group 12 to 13 Years

Statistically significant differences in alveolar bone height were found between the facial types at the central incisor region ($p < .001$) for the 12 to 13 age group. No statistically significant differences were found at the second molar, first molar, or second premolar sites between the facial types (Table 4.9). Bone height successively increased from the posterior region of the mandible to the anterior region of the mandible in all facial types (Figure 4.10). The hyperdivergent facial type had the greatest alveolar bone height at the central incisor region and the shortest alveolar bone height at the second molar region. The hypodivergent facial type had the greatest alveolar bone height at the second molar region and the shortest alveolar bone height at the central incisor region.

Age Group 14 to 15 Years

Statistically significant differences in alveolar bone height were found between the facial types at the central incisor region ($p = .004$) in the mandible for the 14 to 15 age group. No statistically significant differences were found at the second molar, first molar, or second premolar sites between the facial types (Table 4.9). Bone height successively increased from the posterior region of the mandible to the anterior region of the mandible in all facial types (Figure 4.11). The hyperdivergent facial type had the greatest alveolar bone height at the central incisor region and the shortest alveolar bone height at the second molar region. The hypodivergent facial type had the greatest alveolar bone height at the second molar region and the shortest alveolar bone height at the central incisor region.

Age Group 16 to 18 Years

Statistically significant differences in alveolar bone height were found between the facial types at the second molar region (p = .044) in the mandible for the 16 to 18 age group. No statistically significant differences were found at the first molar, second premolar, or lower central incisor sites between the facial types (Table 4.9). Bone height successively increased from the posterior region of the mandible to the anterior region of the mandible in all facial types (Figure 4.12). The hyperdivergent facial type had the greatest alveolar bone height at the central incisor region and the shortest alveolar bone height at the second molar region. The hypodivergent facial type had the greatest alveolar bone height at the second molar region and shorter alveolar bone height at the central incisor region.

Table 4.9

Means and Standard Deviations of Alveolar Bone Height

	Hypo		Norm		Hyper		Norm vs Hypo vs Hyper p < 0.05
	Mean (mm)	SD	Mean (mm)	SD	Mean (mm)	SD	
Age Group 12-13							
BHT2M	21.97	1.73	22.51	1.72	21.29	1.75	.053
BHT1M	23.28	1.87	24.32	2.13	23.94	2.07	.343
BHT2P	24.15	2.49	25.39	2.37	25.49	2.22	.264
BHTCI	25.89	2.39	27.53	2.52	30.17	3.72	.000*
Age Group 14-15							
BHT2M	23.93	2.10	23.44	2.15	22.65	2.05	.174
BHT1M	25.93	3.19	25.45	2.37	25.44	2.34	.827
BHT2P	26.43	2.96	26.90	2.49	27.29	2.24	.609
BHTCI	27.15	2.65	28.80	3.38	30.70	2.64	.004*
Age Group 16-18							
BHT2M	25.83	2.10	24.10	2.29	23.24	2.19	.044*
BHT1M	27.54	2.59	26.83	2.09	27.00	2.87	.857
BHT2P	29.63	2.81	28.23	2.03	29.12	2.61	.522
BHTCI	29.88	3.09	29.14	2.60	31.62	3.21	.129

Note. *p < .05

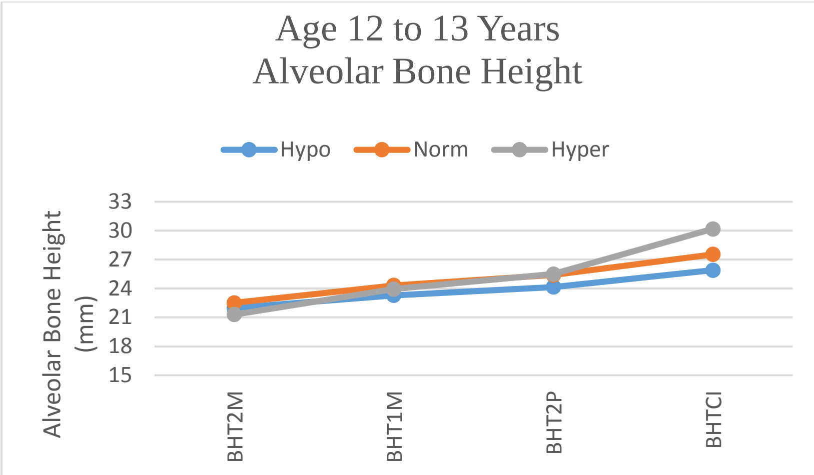

Figure 4.10. Alveolar Bone Height for All Facial Types Age 12 to 13 Years

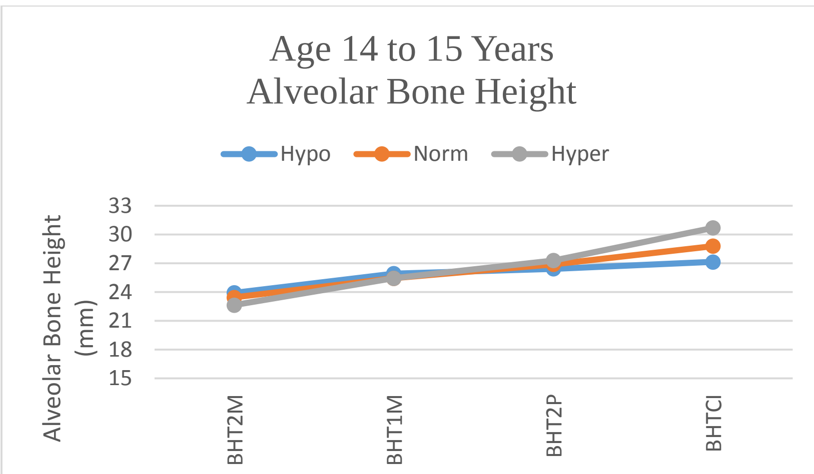

Figure 4.11. Alveolar Bone Height for All Facial Types Age 14 to 15 Years

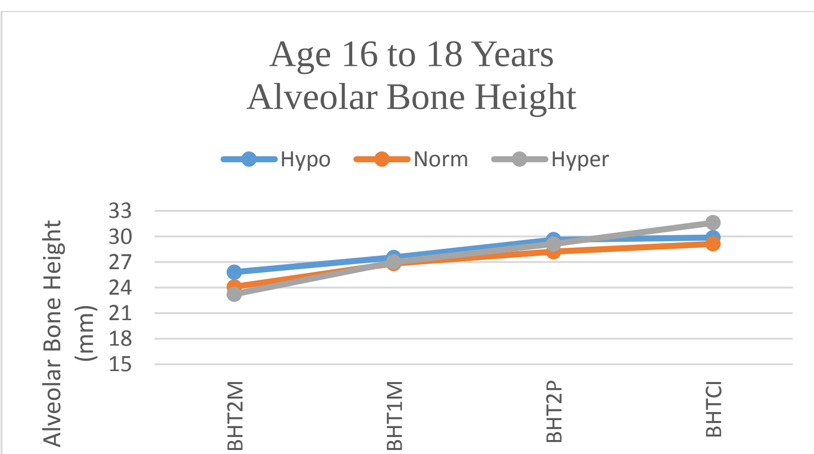

Figure 4.12. Alveolar Bone Height for All Facial Types Age 16 to 18 Years

Research Question 4

Is there a difference in the mandibular alveolar bone width between adolescents with normodivergent, hypodivergent, and hyperdivergent facial types? **Hypothesis**: There is a difference in the mandibular alveolar bone width between adolescents with normodivergent, hypodivergent, and hyperdivergent facial types. **Null Hypothesis**: There is no difference in the mandibular alveolar bone width between adolescents with normodivergent, hypodivergent, and hyperdivergent facial types. The null hypothesis was rejected. ANOVA and Post-Hoc Scheffé analysis (Appendix C) were conducted and statistically significant differences were found in mean alveolar bone width between the facial types in all age groups (Table 4.10 and Table 4.11).

Age Group 12 to 18 Years

Statistically significant differences were found in mean alveolar bone width between the facial types for the 12 to 18 age group at the upper second molar region at BW132M ($p = .044$), at the upper first molar region at BW131M ($p = .001$), at the upper second premolar region at BW132P ($p < .001$), and at the upper and lower central incisor region at BW13CI ($p < .001$) and at BW23CI ($p < .001$) (Table 4.10). Bone width successively decreased from the posterior region of the mandible to the anterior region of the mandible in all facial types. The exception was at 2/3^{rds} height of the alveolar bone at the central incisor region (BW23CI) where the bone width was sometimes greater than in the posterior region (Figure 4.13). The hypodivergent facial type had greater alveolar bone width in general than the normodivergent and hyperdivergent facial types. The normodivergent facial type had greater bone width than the hyperdivergent facial type at most sites.

Table 4.10

Means and Standard Deviations of Alveolar Bone Width

	Hypo		Norm		Hyper		Norm vs Hypo vs Hyper p < 0.05
	Mean (mm)	SD	Mean (mm)	SD	Mean (mm)	SD	
Age Group 12-18							
BW132M	15.08	1.41	14.62	1.48	14.26	1.52	.044*
BW232M	11.51	1.26	10.92	1.36	11.18	1.31	.105
BW131M	13.77	1.17	13.11	1.37	12.60	1.55	.001*
BW231M	10.82	1.38	10.17	1.48	10.20	1.70	.126
BW132P	12.31	1.44	11.62	1.53	10.87	1.63	.000*
BW232P	10.54	1.34	9.99	1.45	9.83	1.77	.116
BW13CI	9.16	1.40	8.31	1.31	7.12	1.39	.000*
BW23CI	14.74	2.28	13.47	1.79	12.30	1.82	.000*

Note. *p < .05

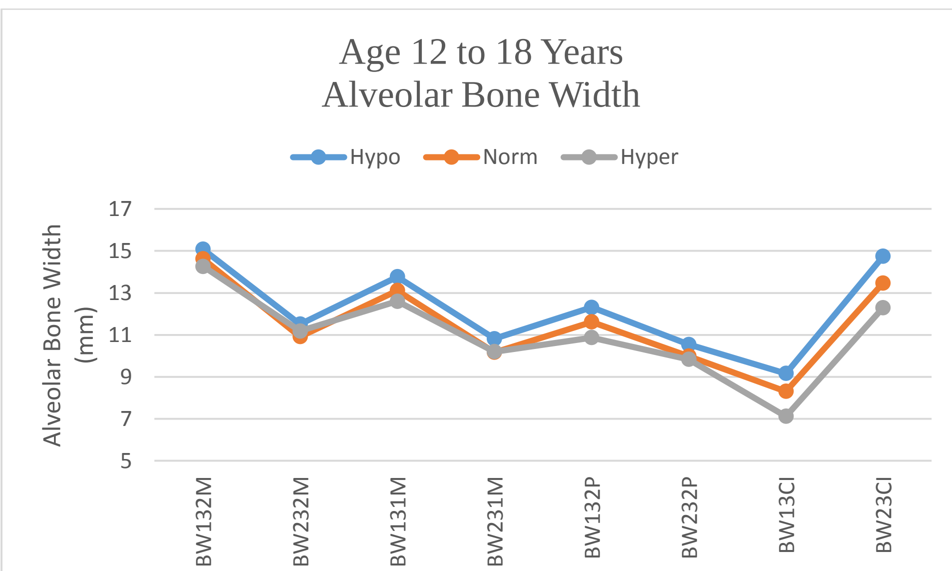

Figure 4.13. Alveolar Bone Width for All Facial Types Age 12 to 18 Years

Age Groups Subdivided

Age Group 12 to 13 Years

Statistically significant differences were found in the alveolar bone width between the facial types for the 12 to 13 age group at the upper first molar region at BW131M ($p = .008$), second premolar region at BW132P ($p = .004$), and at the central incisor region at BW13CI ($p < .001$). No statistically significant differences in alveolar bone width was found at the second molar region between the facial types (Table 4.11). Bone width successively decreased from the posterior region of the mandible to the anterior region of the mandible in all facial types. The exception was at $2/3^{rds}$ height of the alveolar bone at the central incisor region (BW23CI) where the bone width was sometimes greater than in the posterior region (Figure 4.14). The hypodivergent facial type had wider alveolar bone width in general than the normodivergent and hyperdivergent facial types. The normodivergent facial type had greater bone width than the hyperdivergent facial type at most sites

Age Group 14 to 15 Years

Statistically significant differences were found in the alveolar bone width between the facial types for the 14 to 15 age group at the upper and lower central incisor region at BW13CI ($p < .001$) and BW23CI ($p < .001$). No statistically significant differences in alveolar bone width were found at the second molar, first molar, or second premolar region between the facial types (Table 4.11). Bone width successively decreased from the posterior region of the mandible to the anterior region of the mandible in all facial types. The exception was at $2/3^{rds}$ height of the alveolar bone at the central incisor region (BW23CI) where the bone width was sometimes greater than in the posterior region (Figure 4.15). The hypodivergent facial type had wider alveolar bone width in general than the normodivergent and hyperdivergent facial types. The normodivergent facial type had greater bone width than the hyperdivergent facial type at most sites.

Age Group 16 to 18 Years

Statistically significant differences were found between the facial types in the alveolar bone width for the 16 to 18 age group at the upper second premolar region at BW132P (p = .024) and at the upper and lower central incisor region at BW13CI (p = .009) and at BW23CI (p = .001). No statistically significant differences in width were found at the second molar or first molar region between the facial types (Table 4.11). Bone width successively decreased from the posterior region of the mandible to the anterior region of the mandible in all facial types. The exception was at 2/3^{rds} height of the alveolar bone at the central incisor region (BW23CI) where the bone width was sometimes greater than in the posterior region (Figure 4.15). The hypodivergent facial type had wider alveolar bone width in general than the normodivergent and hyperdivergent facial types. The normodivergent facial type had greater bone width than the hyperdivergent facial type at most sites

Table 4.11

Means and Standard Deviations of Alveolar Bone Width

	Hypo		Norm		Hyper		Norm vs Hypo vs Hyper p < 0.05
	Mean (mm)	SD	Mean (mm)	SD	Mean (mm)	SD	
Age Group 12-13							
BW132M	15.36	.87	14.43	1.56	14.64	1.19	.157
BW232M	11.48	.85	10.88	1.31	11.15	1.25	.350
BW131M	14.26	.98	12.93	1.39	12.82	1.24	.008*
BW231M	11.21	1.12	10.15	1.52	10.23	1.33	.090
BW132P	13.07	1.40	11.49	1.49	11.34	1.35	.004*
BW232P	10.86	1.16	10.03	1.56	10.02	1.39	.229
BW13CI	9.48	1.00	8.47	1.41	7.55	.90	.000*
BW23CI	13.76	1.63	13.38	1.94	12.42	2.05	.123
Age Group 14-15							
BW132M	15.12	1.88	14.80	1.44	14.14	1.56	.132
BW232M	12.01	1.03	10.95	1.46	11.16	1.32	.069
BW131M	13.38	1.40	13.22	1.38	12.56	1.56	.147
BW231M	10.52	1.27	10.18	1.53	10.05	2.02	.732
BW132P	11.99	1.56	11.62	1.58	10.78	1.81	.063
BW232P	10.41	1.56	9.94	1.38	9.73	2.21	.54
BW13CI	9.49	1.27	8.23	1.24	7.29	1.57	.000*
BW23CI	15.16	2.18	13.63	1.67	12.52	1.91	.000*
Age Group 16-18							
BW132M	14.59	1.20	14.56	1.35	14.02	1.79	.603
BW232M	10.72	1.83	10.96	1.29	11.25	1.43	.714
BW131M	13.67	.79	13.34	1.25	12.40	1.87	.141
BW231M	10.70	1.92	10.20	1.21	10.39	1.62	.819
BW132P	11.65	.74	12.12	1.52	10.49	1.59	.024*
BW232P	10.28	1.27	10.10	1.38	9.76	1.46	.671
BW13CI	8.11	1.78	7.98	1.32	6.38	1.34	.009*
BW23CI	15.56	3.00	13.14	1.78	11.84	1.39	.001*

Note. *p < .05

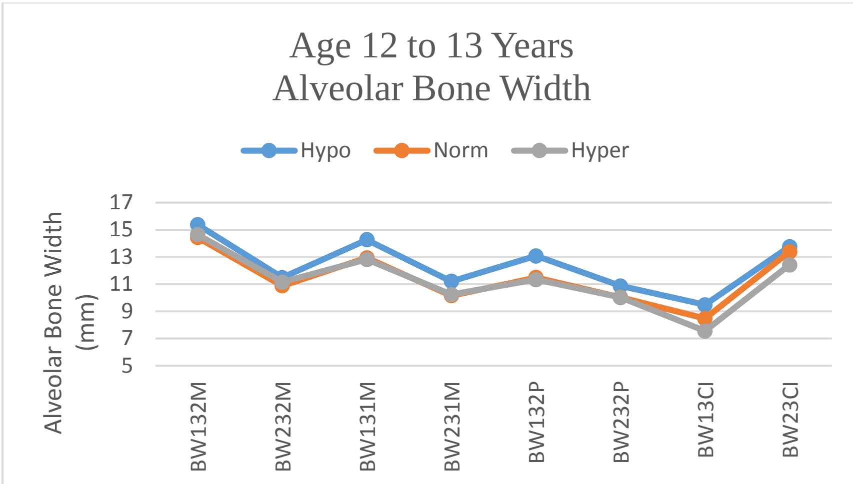

Figure 4.14. Alveolar Bone Width for All Facial Types Age 12 to 13 Years

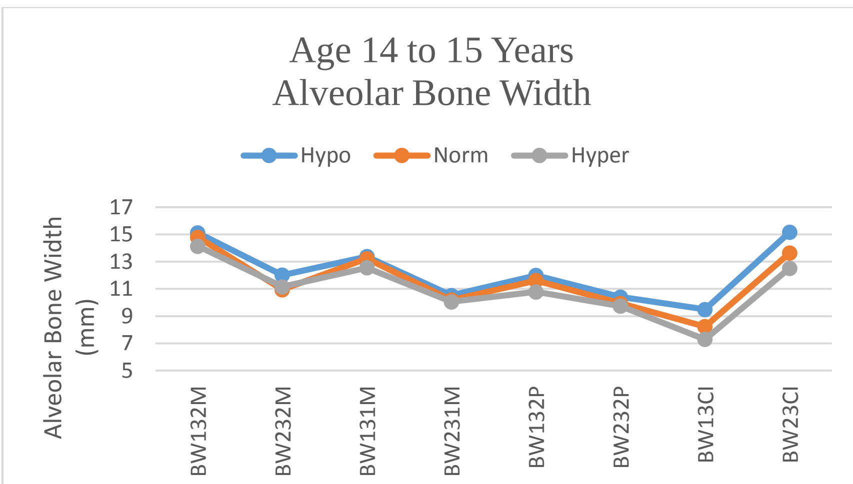

Figure 4.15. Alveolar Bone Width for All Facial Types Age 14 to 15 Years

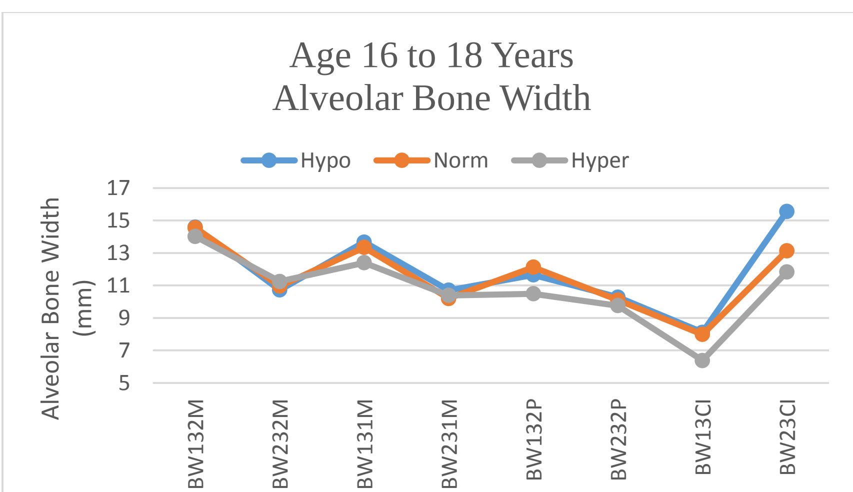

Figure 4.16. Alveolar Bone Width for All Facial Types Age16 to 18 Years

Research Question 5

Is there a difference in the buccolingual tooth inclination between adolescents with normodivergent, hypodivergent, and hyperdivergent facial types? **Hypothesis:** There is a difference in the buccolingual tooth inclination between adolescents with normodivergent, hypodivergent, and hyperdivergent facial types. **Null Hypothesis:** There is no difference in the buccolingual tooth inclination between adolescents with normodivergent, hypodivergent, and hyperdivergent facial types. The null hypothesis was rejected. ANOVA and Post-Hoc Scheffé analysis (Appendix C) were conducted and statistically significant differences were found in the tooth inclination between the facial types in three of the four age groups (Table 4.12 and Table 4.13).

Age Group 12 to 18 Years

Statistically significant differences in tooth inclination were found between the facial types for the second premolar ($p = .002$) and central incisor ($p < .001$) for the 12 to 18 age group (Table 4.12). At the second premolar the hypodivergent facial type had the largest buccolingual inclination angle at 82 degrees and the hyperdivergent facial type had the lowest buccolingual inclination angle at 78 degrees. At the central incisor, the hypodivergent facial type had the largest labiolingual inclination at 98 degrees and the hyperdivergent facial type had the lowest labiolingual inclination at 91 degrees. In each facial type, the tooth inclination successively increased from the posterior region of the mandible to the anterior region (Figure 4.17). Hypodivergent subjects had more upright posterior teeth and more proclined central incisor than the normodivergent and hyperdivergent subjects.

Table 4.12

Means and Standard Deviations of Tooth Inclination

	Hypo		Norm		Hyper		Norm vs Hypo vs Hyper p < 0.05
	Mean (°)	SD	Mean (°)	SD	Mean (°)	SD	
Age Group 12-18							
TIncl2M	71.37	7.02	71.71	6.35	70.96	7.08	.804
TIncl1M	75.99	4.73	75.04	4.53	74.32	5.39	.306
TIncl2P	82.39	6.17	81.60	6.07	78.48	5.83	.002*
TInclCI	97.99	8.84	95.54	7.18	90.67	6.57	.000*

Note. *p < .05

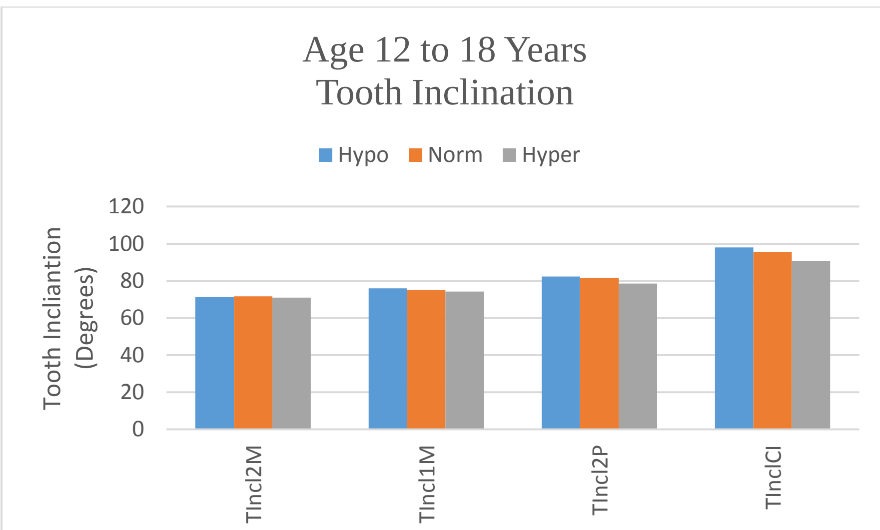

Figure 4.17. Tooth inclination for all Facial Types Age 12 to 18 Years

Age Groups Subdivided

Age Group 12 to 13 Years

No Statistically significant differences were found in tooth inclination between the facial types for the 12 to 13 age group (Table 4.13). In each facial type, the tooth inclination successively increased from the posterior region of the mandible to the anterior region (Figure

4.18). Hypodivergent subjects also had more upright posterior teeth than the normodivergent subjects. The normodivergent subjects had more upright posterior teeth than the hyperdivergent subjects. At the central incisor, the hypodivergent facial type had the largest labiolingual inclination at 97 degrees and the hyperdivergent facial type had the lowest labiolingual inclination at 93 degrees.

Age Group 14 to 15 Years

Statistically significant differences were found in the tooth inclination between the facial types for the second premolar ($p < .001$) and central incisor ($p = .001$) for the 14 to 15 age group (Table 4.13). At the second premolar the hypodivergent facial type had the largest buccolingual inclination angle at 83 degrees and the hyperdivergent facial type had the lowest buccolingual inclination angle at 78 degrees. At the central incisor, the hypodivergent facial type had the largest labiolingual inclination at 97 degrees and the hyperdivergent facial type had the lowest labiolingual inclination at 89 degrees. In each facial type, the tooth inclination successively increased from the posterior region of the mandible to the anterior region (Figure 4.19). Hypodivergent subjects also had more upright posterior teeth than the normodivergent subjects. The normodivergent subjects had more upright posterior teeth than the hyperdivergent subjects.

Age Group 16 to 18 Years

Statistically significant difference was found in the tooth inclination between the facial types for the central incisor ($p = .006$) for the 16 to 18 age group (Table 4.13). At the central incisor, the hypodivergent facial type had the largest labiolingual inclination at 100 degrees and the hyperdivergent facial type had the smallest labiolingual inclination at 89 degrees. The tooth inclination successively increased from the posterior region of the mandible to the anterior region at all locations measured in each facial type (Figure 4.20). Hypodivergent subjects also had more upright posterior teeth than the normodivergent subjects and the normodivergent subjects had more upright posterior teeth than the hyperdivergent subjects.

Table 4.13

Mean and Standard Deviations of Tooth Inclination

	Hypo		Norm		Hyper		Norm vs Hypo vs Hyper p < 0.05
	Mean (°)	SD	Mean (°)	SD	Mean (°)	SD	
Age Group 12-13							
TIncl2M	68.26	6.87	71.55	7.44	69.95	7.32	.400
TIncl1M	75.42	2.62	75.07	4.58	75.41	3.91	.945
TIncl2P	81.67	5.54	81.09	5.83	79.94	6.59	.706
TInclCI	96.76	7.20	94.82	7.54	93.48	6.55	.488
Age Group 14-15							
TIncl2M	72.13	6.41	71.28	5.46	70.89	7.39	.857
TIncl1M	75.15	5.39	74.91	4.79	73.91	6.00	.712
TIncl2P	83.48	6.17	81.92	6.34	78.40	5.62	.029*
TInclCI	97.70	9.32	96.13	7.16	89.48	6.24	.001*
Age Group 16-18							
TIncl2M	74.94	7.09	74.10	5.21	72.18	6.56	.570
TIncl1M	78.31	5.92	75.50	3.50	73.72	5.99	.183
TIncl2P	81.66	7.70	82.18	6.34	76.98	5.11	.077
TInclCI	100.40	11.07	95.88	6.21	89.28	6.44	.006*

Note. $^*p < .05$

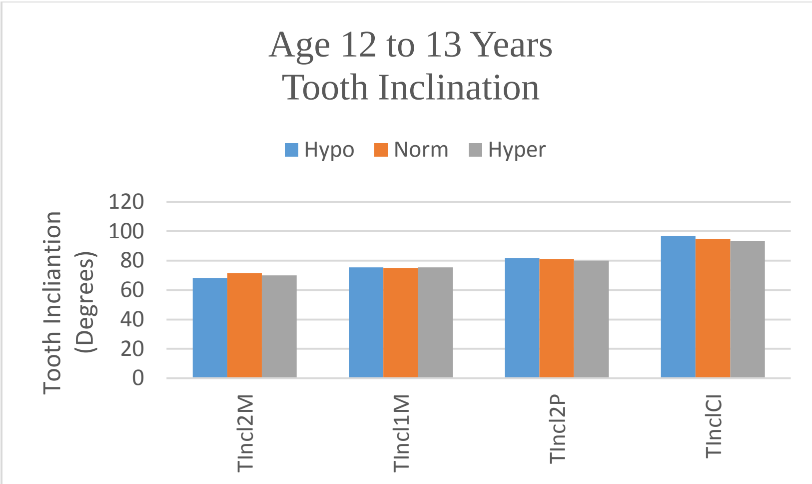

Figure 4.18. Tooth inclination for all Facial Types Age 12 to 13 Years

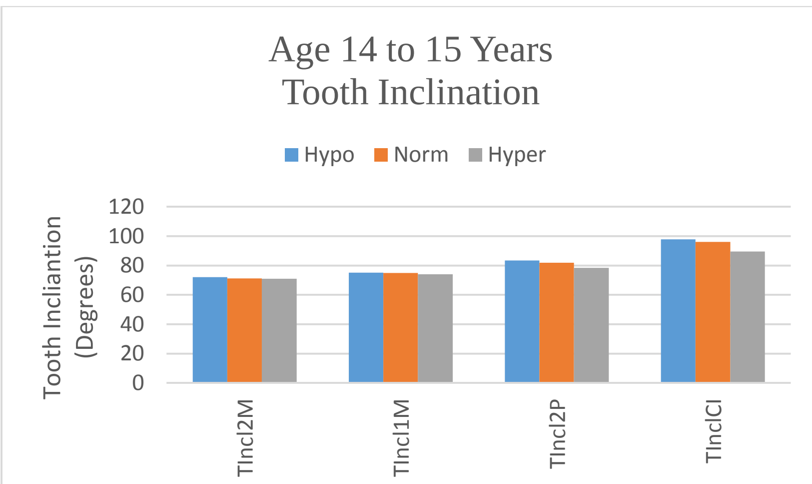

Figure 4.19. Tooth inclination for all Facial Types Age 14 to 15 Years

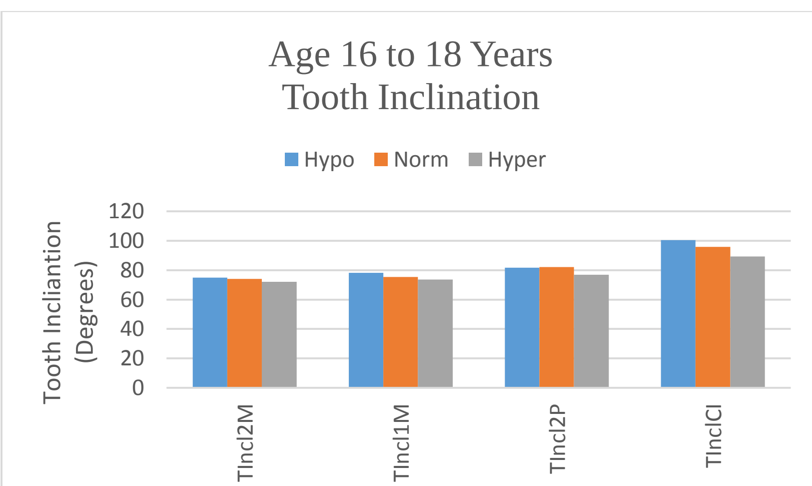

Figure 4.20. Tooth inclination for all Facial Types Age 16 to 18 Years

Research Question 6

Is there a difference in the buccolingual inclination of mandibular alveolar bone between adolescents with normodivergent, hypodivergent, and hyperdivergent facial types?

Hypothesis: There is a difference in the buccolingual inclination of mandibular alveolar bone between adolescents with normodivergent, hypodivergent, and hyperdivergent facial types.

Null Hypothesis: There is no difference in the buccolingual inclination of mandibular alveolar bone in adolescents with normodivergent, hypodivergent, and hyperdivergent facial types. The null hypothesis was rejected. ANOVA and Post-Hoc Scheffé analysis (Appendix C) were conducted and statistically significant differences were found in the alveolar bone inclination between the facial types in all age groups (Table 4.14 and Table 4.15).

Age Group 12 to 18 Years

Statistically significant difference in the alveolar bone inclination was found between the facial types at the second molar region ($p = .039$) for the 12 to 18 age group (Table 4.14). The mean bone inclination of the second molar region was 67 degrees in the hypodivergent group, 66 degrees in the normodivergent group, and 64 degrees in the hyperdivergent group. This indicated that the bone was more upright in the second molar region for the hypodivergent facial types than the other two groups. The mean bone inclination increased from the posterior region of the mandible to the anterior region at all locations measured (Figure 4.21). The mean bone inclination was 67 degrees in the second molar region and it increased to 87 degrees in the anterior region for the hypodivergent group. A similar trend was also noted in the normodivergent and hyperdivergent facial types as well.

Table 4.14

Means and Standard Deviation of Alveolar Bone Inclination

	Hypo		Norm		Hyper		Norm vs Hypo vs Hyper p < 0.05
	Mean (°)	SD	Mean (°)	SD	Mean (°)	SD	
Age Group 12-18							
BIncl2M	66.91	5.69	66.20	4.23	64.45	5.33	.039*
BIncl1M	74.15	5.60	73.94	4.16	73.51	4.96	.795
BIncl2P	78.17	5.34	78.64	3.94	78.61	4.09	.868
BInclCI	87.03	7.22	86.49	5.11	84.53	6.06	.074

Note. *p < .05

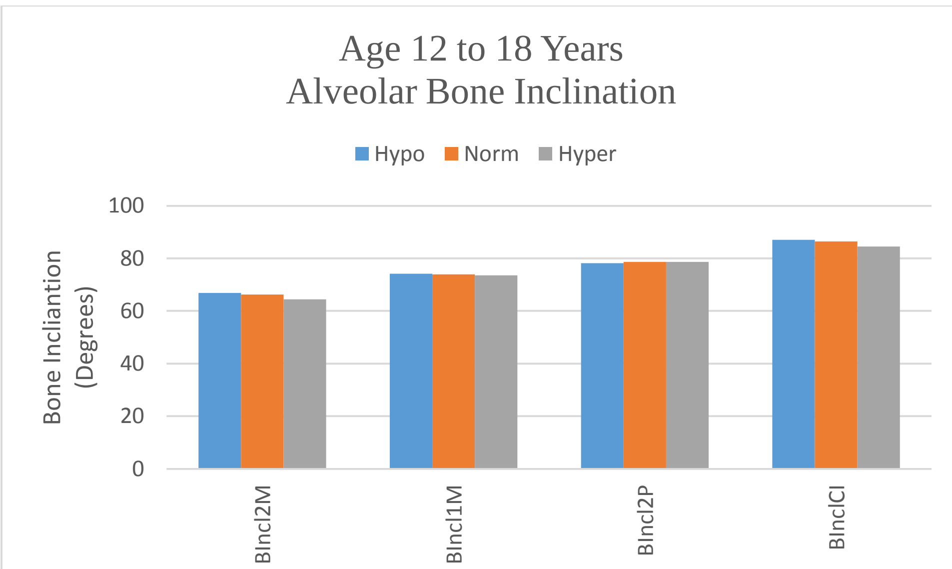

Figure 4.21. Bone inclination for all Facial Types Age 12 to 18 Years

Age Groups Subdivided

Age Group 12 to 13 Years

Statistically significant differences were found in the alveolar bone inclination between the facial types at the second premolar region (p = .013) for the 12 to 13 age group (Table 4.15). The mean bone inclination at the second premolar was 75 degrees for the hypodivergent facial type, 78 degrees for the normodivergent facial type, and 79 degrees for the hyperdivergent facial type. The bone inclination successively increased from the posterior region of the mandible to the anterior region at all locations measured for all facial types (Figure 4.22). The alveolar bone was more lingually inclined in the posterior mandible in the hypodivergent facial type than other facial types which differed from the other age groups where the alveolar bone was more upright.

Age Group 14 to 15 Years

Statistically significant differences were found in the alveolar bone inclination between the facial types for the second molar region ($p = .041$) and the central incisor region ($p = .031$) for the 14 to 15 age group (Table 4.15). The mean bone inclination at the second molar was 67 degrees for the hypodivergent facial type, 66 degrees for the normodivergent facial type, and 44 degrees for the hyperdivergent facial type. The mean bone inclination at the central incisor was 87 degrees for the hypodivergent facial type, 87 degrees for the normodivergent facial type, and 84 degrees for the hyperdivergent facial type. The bone inclination angle increased from the posterior region of the mandible to the anterior region of the mandible at all locations measured (Figure 4.23). The posterior alveolar bone was more upright in the hypodivergent than in the normodivergent and hyperdivergent group.

Age Group 16 to 18 Years

Statistically significant differences were found in the alveolar bone inclination between the facial types at the central incisor region ($p = .005$) for the 16 to 18 age group (Table 4.15). The mean bone inclination at the central incisor was at 92 degrees for the hypodivergent facial type, at 85 degrees for the normodivergent facial type, and at 83 degrees for the hyperdivergent facial type. The bone inclination angle increased from the posterior region of the mandible to the anterior region of the mandible at all locations measured (Figure 4.24). The posterior alveolar bone was more upright in the hypodivergent group than in the normodivergent and hyperdivergent group.

Table 4.15

Means and Standard Deviation of Alveolar Bone Inclination

	Hypo		Norm		Hyper		Norm vs Hypo vs Hyper p < 0.05
	Mean (°)	SD	Mean (°)	SD	Mean (°)	SD	
Age Group 12-13							
BIncl2M	64.85	4.64	65.05	4.21	65.25	4.70	.970
BIncl1M	70.99	3.49	72.93	3.91	74.04	3.91	.121
BIncl2P	74.86	3.76	78.17	3.60	78.90	3.65	.013*
BInclCI	83.69	6.42	85.27	4.99	86.47	6.30	.429
Age Group 14-15							
BIncl2M	67.27	5.27	66.49	3.88	63.69	5.76	.041*
BIncl1M	75.16	5.48	74.33	4.24	72.44	5.19	.183
BIncl2P	79.58	4.33	78.59	4.30	77.89	4.34	.536
BInclCI	87.32	5.87	87.91	5.28	83.93	6.58	.031*
Age Group 16-18							
BIncl2M	69.56	7.30	69.43	4.31	64.67	5.49	.064
BIncl1M	77.39	6.60	76.24	4.04	74.51	5.61	.47
BIncl2P	80.97	6.83	80.64	3.33	79.34	4.25	.67
BInclCI	91.80	8.52	85.26	3.37	83.25	4.65	.005*

Note. *p < .05

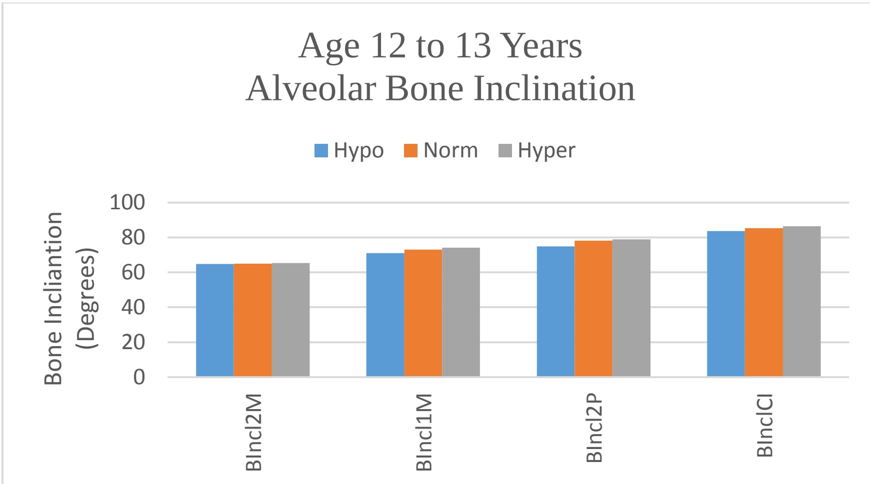

Figure 4.22. Bone inclination for all Facial Types Age 12 to 13 Years

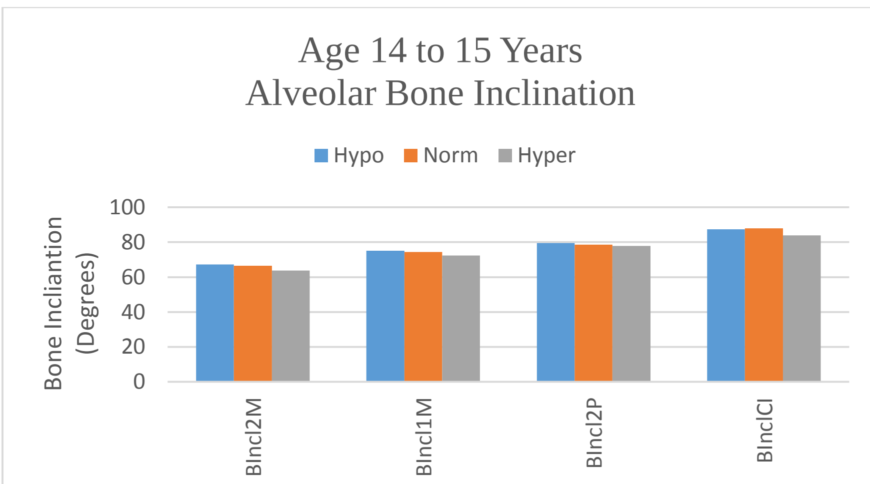

Figure 4.23. Bone inclination for all Facial Types Age 14 to 15 Years

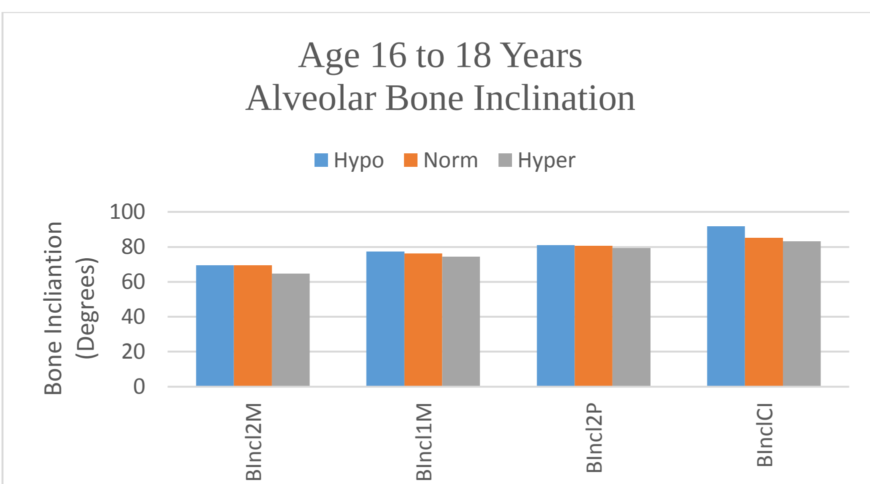

Figure 4.24. Bone inclination for all Facial Types Age 16 to 18 Years

Chapter 5: Discussion and Conclusion

The primary goal of this research project was to use the improved imaging capability of the CBCT to investigate the relationship between vertical facial patterns and mandibular tooth-alveolar morphology in the adolescent population. Prior studies focused mainly on the adult population and this study was designed to identify the characteristics of subjects 12 to 18 years of age which comprise the main treatment population of the orthodontic practice. The study population was subdivided into 12 to 13, 14 to 15, and 16 to 18 age groups in order to evaluate any changes associated with growth. When subjects were classified in their respective age subgroups, however, statistical power decreased due to the limited sample size. Therefore, subjects were also evaluated in the combined 12 to 18 age group for an investigation of the adolescent population as a whole. Overall, statistically significant differences were found between the facial types in all of the categories measured including cortical bone thickness, alveolar bone height, alveolar bone width, tooth inclination, and bone inclination measurements.

Age Group 12 to 18 Years

Cortical Bone Thickness

For the combined age group, statistically significant differences were found between the different facial types at all sites measured for the cortical bone. The measurements included the buccal and lingual cortical bone thickness at the second molar, first molar, second premolar, and central incisor region. The hypodivergent facial type had consistently greater cortical bone thickness than the normodivergent and the hyperdivergent facial types. The normodivergent facial type had consistently greater cortical bone thickness than the hyperdivergent facial type at almost all sites. These finding are consistent with the studies by Tsunori et al. (1998) and Matsumoto et al. (2001) on CT scans of dry skulls of adult Asiatic Indians where researchers found the thickness of buccal cortical bone in hypodivergent subjects was greater than that of normodivergent or hyperdivergent subjects at all sites measured. The CBCT study by Swasty et al. (2011), which measured cortical bone thickness in a combined age group of 10 to 65 years, had similar findings but noted that the most significant correlation of cortical bone thickness and facial type applied to the upper buccal cortical bone of the mandible. No significant correlation was found in that study between facial types and the lower lingual cortical bone. This difference in finding may be due to the wide age range of subjects included in the investigation as patients at the higher and lower end of the age spectrum could have significant differences in cortical bone thickness. This study, however, found statistically significant differences at all sites measured between the facial types in the 12 to 18 age group. It appears that in the adolescent age group, as with adults, the same correlations of the short-faced type with thicker cortical bone and the long-faced type with thinner cortical bone exists.

The findings in this study can be attributed to the adaptation of cortical bone to loading forces and functional demands. Cortical bone thickness, shape, and mineralization are not only influenced by genetics but also by environmental factors as well. Cortical bone thickness correlates with the amount of loading forces developed through the dentition as muscles contract (Bresin et al., 1999). Bone mass and remodeling varies depending on function and also on the region of muscle attachment. Reduced muscle function is associated with a reduced amount of cortical and trabecular bone in the dentoalveolar process (Bresin et al., 1999). The size and orientation of the masticatory muscles and the forces that they generate also affect the development of the maxillofacial complex and facial divergence (Chan et al., 2008; Satiroglu et al., 2005). In addition, increased facial divergence has been found to be associated with reduced muscle function (Garcia-Morales et al., 2003). The finding in this study that short-faced subjects had thicker cortical bone and long faced subjects had thinner cortical bone is consistent with the existing evidence regarding muscle function, facial type, and cortical bone mineralization. In addition, the tensile stress and strain during biting has been found to be greatest at the lower lingual region of the mandibular symphysis and least on the upper buccal region of the symphysis (Korioth, Romilly, & Hannam, 1992). Consequently, in this study, the thickest cortical bone of the mandible was found at the lower lingual 1/3rd region of the symphysis while the thinnest cortical bone was located at the upper buccal 1/3rd region of the symphysis. Results of this investigation provides further evidence that cortical bone thickness is influenced by functional forces.

The findings in this study have significant implications for various disciplines in dentistry including orthodontics. The thickness of cortical bone is strongly correlated with the success rate of mini-implants and greater than 1mm of bone should be present to ensure primary stability (Motoyoshi et al., 2009). Some studies have also found that mini-implants inserted in adolescents tended to fail at a higher rate than those placed in adults due to less mature and thinner cortical bone (Chen, Chang, & Huang, 2007; Farnsworth, Rossouw, Ceen, & Buschang, 2011). Therefore, knowledge of the buccal cortical bone thickness of adolescents with different facial types is important in order to determine the ideal placement sites for mini-implants. The mean cortical bone thicknesses of subjects in this study ranged from 1.27mm (±0.27) to 2.99mm (±0.52). The hypodivergent facial type has been found in this study to have thicker cortical bone than the hyperdivergent facial type and therefore adolescents with the horizontal growth pattern may have better primary stability with miniscrews. Cortical bone thickness increased successively from the anterior mandible to the posterior mandible. Since cortical bone thickness is directly related to bone screw stability, the results suggests that posterior regions of the mandible would be more ideal for mini-implant placement. Caution should be taken in placing mini-implants in hyperdivergent adolescents in the anterior and premolar regions of the mandible as buccal cortical bone ranged from 1.27mm (±0.27) to 1.71mm (±0.38), which is only slightly greater than 1mm. A more predictable area for placement would be near the first and second molar region where buccal cortical bone ranged from 1.9mm (±0.45) to 2.39mm (±0.45).

In addition, there are periodontal concerns regarding the thin buccal cortical bone overlying the upper one third of the lower central incisor for the hyperdivergent subjects as the mean value was only at 1.27mm (±0.27). Lower incisors should not be proclined excessively in orthodontic treatment mechanics to avoid dehiscence, recession, and other iatrogenic problems. Periodontists should also be aware of the existence of thinner cortical bone in the mandible when treating long faced patients and the increased possibility of recession and bone loss in this population.

Alveolar Bone Height

Statistically significant differences were found between the facial types in the alveolar bone height at the central incisor and second molar region of the mandible in the 12 to 18 age group. The hyperdivergent facial type had the greatest alveolar bone height compared with the other facial types at the central incisor region and the shortest alveolar bone height at the second molar region. The hypodivergent facial type had the greatest alveolar bone height at the second molar region and the shortest alveolar bone height at the central incisor region. This is consistent with past research that concluded that lower anterior facial heights were longer, mandibular plane angles were higher, and the ramus heights were shorter in patients with a long face (Fields et al., 1984; Schendel et al., 1976). The shorter ramus height in long-faced individuals accounts for the finding of consistently shorter alveolar bone height in the hyperdivergent group in the posterior mandible near the second molar region. The longer alveolar bone height at the central incisor in the hyperdivergent subjects was the result of dental compensation for the longer lower anterior face heights as teeth extrude to meet opposing teeth and the alveolar process elongate as a consequence. The findings in this study on alveolar bone height are consistent with the findings in other studies that focused on adults (Kohakura et al., 1997; Swasty et al., 2011; Han et al., 2013). The finding that mandibular alveolar bone height of patients varied with the horizontal and vertical facial patterns supports the idea that the height of the mandibular alveolar bone is associated with the growth pattern. The same correlations previously found in studies in adults were also found in this investigation of the adolescent age group.

The patterns found with regards to alveolar bone height in this study are consistent with the current understanding of typical mandibular bone response to stress, strain, bending, and torsion when the mandible is in function. Past investigations have found an increase in bone remodeling and vertical depth of the mandibular corpus in macaques as a result of increased stress induced by mastication of hard foods and in response to increased sagittal mandibular bending (Bouvier & Hylander, 1981; Hylander, Johnson, & Crompton, 1987). Greater depth of the mandible was found as an adaptive response to increased stress levels associated with greater mastication forces associated with a harder diet (Bouvier & Hylander, 1981; Hylander et al., 1987). It has been noted that long-faced individuals have lower and short-faced individuals have higher maximum biting forces than those with normal vertical dimensions (Proffit, Fields, & Nixon, 1983; Throckmorton, Finn, & Bell, 1980). It has also been suggested that those with an acute gonial angle and longer posterior facial heights, all characteristics of the hypodivergent facial type, are better suited to produce higher bite forces (Korioth et al., 1992). The greater masticatory forces associated with the short-faced individual accounted for the increased vertical height in the posterior mandible found in this study. The adaptive response of bone as a result of varying levels of stress induced by the bite force resulted in differences in vertical depth of the mandible between the hypodivergent and hyperdivergent facial types.

Alveolar Bone Width

Statistically significant differences were found between the facial types in the alveolar bone width for the 12 to 18 age group at the upper second molar region, the upper first molar region, the upper second premolar region, and at the upper and lower central incisor region. Bone width successively decreased from the posterior region of the mandible to the anterior region of the mandible in all facial types except at 2/3^{rds} height of the alveolar bone at the central incisor region where the bone width was sometimes greater than in the posterior region. The hypodivergent facial type has wider alveolar bone width than the normodivergent and hyperdivergent facial types. The normodivergent facial type has greater bone width than the hyperdivergent facial type at most sites. These findings are consistent with the results of the Swasty et al. (2011) study where the hyperdivergent group exhibited a narrower cross section of the mandible compared with the normodivergent and hypodivergent groups. However, the study by Han et al. (2013) found no significant differences in the mandibular alveolar bone width between the hyperdivergent and hypodivergent group. Han et al. (2013) defined bone width as the greatest length from the buccal side and lingual side of the alveolar bone and the width measurement was drawn parallel to the mandibular plane. These reference points differed from the ones used in this study and the dissimilar measurement techniques may be the reason why there were differing conclusions. In this study, the bone width was found to be the narrowest at the upper third region of the alveolar bone in the central incisor region of the hyperdivergent facial type.

The difference in alveolar bone width between the facial types could be attributed to the variation in bite force, size of masticatory muscles, and region of attachment of masticatory muscles between the three groups. As stated previously, increased facial divergence has been associated with reduced bite force and decreased facial divergence has been associated with larger masticatory muscles and a higher maximum biting force (Garcia-Morales et al., 2003; Throckmorton et al., 1980). Results of various studies confirm that the size of the mandibular muscles is related to skeletal facial width (Kitai et al., 2002; Hannam & Wood, 1989). A study on the primate mandible has shown that jaws are thicker in the transverse dimension in the molar region in order to resist the increase in torsional forces on the working side of the mandibular body during one sided chewing (Hylander, 1979). An increase in the chewing muscle force would also result in an increase in torsional forces on the mandibular body. The increase in alveolar bone width in the hypodivergent subjects can be attributed to an adaptation to resist the increased torsional forces due to greater mastication strength.

The findings regarding alveolar bone width have important implications for various disciplines of dentistry. Care must be exercised in orthodontic treatment mechanics not have excessive labio-lingual movements of the lower incisors in the narrower alveolar ridge of a hyperdivergent patient in order to prevent iatrogenic sequelae such as bony dehiscence and gingival recession. Vigilant planning of tooth movement is needed and attention must be paid to the shape of the symphysis when large anterior posterior movements are needed. In addition, buccolingual movements of the lower posterior teeth should also be limited in the hyperdivergent patient in order to ensure the teeth remain within the limits of the alveolar bone housing. The narrower alveolar bone width for the hyperdivergent population means less buccal lingual width for dental implant placement. Knowledge of the differences in alveolar morphology between the facial divergences would assist oral surgeons or dentists in deciding the proper treatment plan for various surgical and dental procedures. It would also assist with determination of the requirements for successful dental implant placement in these three groups of patients.

Tooth Inclination

Statistically significant differences were found between the facial types in the tooth inclination for the second premolar and the central incisor for the 12 to 18 age group. At the central incisor, the hypodivergent facial type had the largest labiolingual inclination at 98 degrees and the hyperdivergent facial type had the smallest labiolingual inclination at 91 degrees. At the second premolar, the hypodivergent facial type had the largest buccolingual inclination angle at 82 degrees and the hyperdivergent facial type had the smallest buccolingual inclination angle at 78 degrees. These findings are consistent with the studies by Matsumoto et al. (2001) and Han et al. (2013) where posterior teeth of long-faced subjects were found to be more lingually inclined than those of short-faced subjects. These findings, however, contrast with the studies by Kohakura et al. (1997) and Tsunori et al. (1998) where the more upright posterior teeth were found in the long-faced subjects. Mandibular posterior teeth move buccally due to a combination of tongue pressure and masticatory occlusal force (Tsunori et al., 1998). The posterior teeth of hypodivergent patients endure greater masticatory pressure due to stronger muscle forces which may influence the more upright position of the mandibular posterior teeth (Tsunori et al., 1998). Since there are differences in findings between the studies, future research is warranted as the understanding of tooth inclination helps guide treatment decisions on mandibular arch expansion and torque control.

In clinical orthodontic treatment, expansion of the dental arch is commonly performed in order to gain space. Since molars in the hypodivergent patient is found to be more upright, less expansion should be performed to ensure treatment stability. Consequently in the hyperdivergent patient, since molars are more lingually inclined, there is more room for expansion and space creation. More buccal crown torque is also needed in the long face patient in order to level the curve of Wilson. In addition, the difference in antero-posterior position of the lower incisors between the different facial types should be noted for guiding treatment mechanics. Past research has shown that crowding has been associated with vertical growth, increased lower incisor eruption, and increased vertical dentoalveolar eruption (Driscoll-Gilliland, Buschang, & Behrent, 2001). Therefore, hyperdivergent individuals have a tendency for more retroclined incisors which is consistent with the findings in this study. As the inclination of the lower incisors are also influenced by the antero-posterior (AP) position of the maxilla and mandible, in addition to vertical facial type, the reason for the difference in proclination of the lower incisors between the facial types cannot be narrowed down to just one factor. However, it is still important to note the results of this study and its implication on orthodontic treatment planning.

Bone Inclination

Statistically significant differences were found between the facial types in the alveolar bone inclination for the second molar region for the 12 to 18 age group (Table 4.14). The mean bone inclination at the second molar was 67 degrees in the hypodivergent group, 66 degrees in the normodivergent group, and 64 degrees in the hyperdivergent group. The alveolar bone in the hypodivergent facial type was found to be more upright in the posterior region of the mandible and more proclined in the anterior region of the mandible. The mandibular alveolar bone inclination followed the same angulation tendency as the tooth inclination. As masticatory muscles and bite force are greater in the hypodivergent patient and tooth inclination is more upright as a result, it would follow that alveolar bone inclination would be more upright in the posterior mandible as well (Garcia-Morales et al., 2003; Throckmorton et al., 1980). These results suggest that the since both the posterior teeth and alveolar bone are more upright in patients with the horizontal growth pattern, there is less room for arch expansion. In addition, knowledge of the differences in angulation of the alveolar bone is useful when determining the proper insertion angulation when placing dental implants.

Age Groups Subdivided

Cortical Bone Thickness

Statistically significant differences were found between the facial types in the buccal cortical bone thickness at 7 out of 8 sites in the 12 to 13 age group, 8 out of 8 sites in the 14 to 15 age group, and at 4 out of 8 sites in the 16 to 18 age group. Statistically significant differences were found in the lingual cortical bone thickness at 5 out of 8 sites in the 12 to 13 age group, 8 out of 8 sites in the 14 to 15 age group, and 6 out of 8 sites in the 16 to 18 age group. The adolescent growth spurt is characterized by an increase in growth velocity around 10 to 12 years of age for girls and around 12 to 14 years of age for boys (Dean et al., 2011). On average, the adolescent spurt in the growth of the jaws occurs at about the same time as the spurt in height. The growth of the jaws, especially the mandible, follows the general body curve closely (Proffit, Fields, & Sarver, 2013). After the advent of the adolescent growth spurt, a greater degree of change may be exhibited between the facial types in the 14 to 15 age group resulting in a greater number of statistically significant sites. After the pubertal growth spurt, incremental changes in growth tend to decrease. Generally, after the age of 12 in females and 14 in males, the incremental growth per year decreases as exhibited by Figure 5.1.

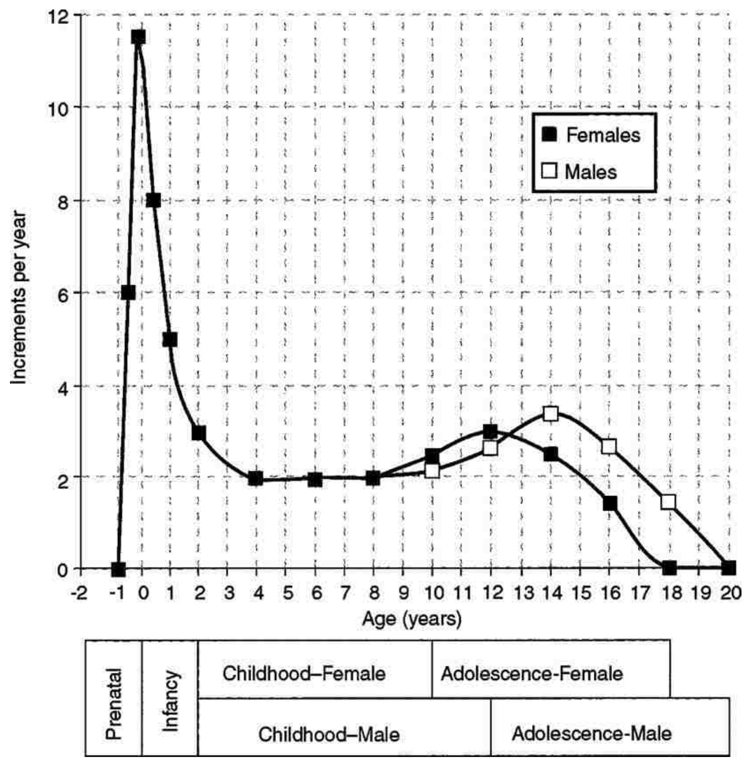

Figure 5.1. Incremental Growth Curve Illustrating Growth Stages.
(Adapted from *McDonald and Avery's Dentistry for the Child and Adolescent* (p. 512), by J. Dean, R. McDonald, and D. Avery, 2011, Maryland Heights, MO: Mosby Inc. Copyright 2011 by Elsevier, Inc)

This decrease in growth rate may account for the decrease in the number of statistically significant sites as subjects mature and individuals begin to reach adult size. Regardless of the decrease in the number of statistically significant sites, however, the absolute cortical bone thickness measurements of the hypodivergent facial type were greater than that of the normodivergent and hyperdivergent facial types in all age groups. In general, the hyperdivergent cortical bone was thinnest among the three facial types.

Alveolar Bone Height

Statistically significant differences were found between the facial types in the alveolar bone heights at the central incisor in the 12 to 13 age group and the 14 to 15 age group. In the 16 to 18 age group there was only a statistically significant difference between facial types in the second molar region. However, past research in adults has found that the hyperdivergent facial type has the largest alveolar bone height in the anterior region (Sadek et al., 2014; Swasty et al., 2011). For the 16 to 18 age group, the mean alveolar bone height at the central incisor region was 31.62mm (±3.21), which was still greater than the 29.88mm (±3.09) height for the hypodivergent facial type, but the difference in values was not statistically significant. The lack of a statistically significant finding at the central incisor region may be due to the smaller sample size of 33 subjects in the 16 to 18 age group. In all age groups, the hyperdivergent facial type generally had the greatest alveolar bone height compared with the other facial types at the central incisor region and the shortest alveolar bone height at the second molar region. The hypodivergent facial type generally had the greatest alveolar bone height at the second molar region and the shortest alveolar bone height at the central incisor region. The finding that the mandibular height of patients varied with the horizontal and vertical facial pattern supports the idea that the height of the mandibular bone is associated with the growth pattern even in the adolescent population.

Alveolar Bone Width

There were statistically significantly differences in the alveolar bone width between the facial types at the upper first molar, upper second premolar, and upper central incisor region in the 12 to 13 age group; at the upper and lower central incisor region in the 14 to 15 age group; and at the upper second premolar and upper and lower central incisor region in the 16 to 18 age group. It appears that in the more mature subjects, the number of statistically significant sites decreased as adolescents begin to reach adult size. Posterior bone width differences between the facial types decreased from the younger 12 to 13 age group to the older 14 to 15 age group and the 16 to 18 age group. However, large differences in width between the facial types remained in the anterior mandible despite changes with age. The hypodivergent facial type still had the greatest absolute mean alveolar bone width compared with the other facial types in all age groups. The hyperdivergent facial type still had the smallest mean cortical bone width versus other facial types at most sites.

Tooth Inclination

No statistically significant differences were found between the facial types in the tooth inclination for the 12 to 13 age group. Statistically significant differences were found at the central incisor and second premolar in the 14 to 15 age group and the central incisor in the 16 to 18 age group. The increase in the number of statistically significant sites in the older subjects may be due to the continued eruption of the permanent teeth as they settle into the adult occlusion. After teeth have erupted into the arch, posteruptive movements that accommodate the growth of the jaws generally occurs between the ages of 14 and 18 years (Nanci, 2008). They are readjustment of the position of the tooth socket, assisted by the formation of new bone at the alveolar crest and on the socket floor to keep pace with the increasing height of the jaws (Nanci, 2008). In the 12 to 13 age group, the second molar was more lingually inclined in the hypodivergent group compared with the other facial types as the second molar may have just erupted into occlusion. However, for all other age groups, the hypodivergent group had consistently more upright posterior teeth and more proclined central incisors than the other facial types. These findings follow the theory that mandibular posterior teeth of hypodivergent subjects endure greater masticatory pressure due to stronger muscle forces which may influence the more upright position of the mandibular posterior teeth (Tsunori et al., 1998). Retroclined lower incisors found in the hyperdivergent group is consistent with past research where high facial angle individuals were found to have more retroclined and crowded incisors (Driscoll-Gilliland et al., 2001).

Bone Inclination

Statistically significant differences in bone inclination between the facial types were found at the second premolar region in the 12 to 13 age group, the central incisor region in the 14 to 15 and 16 to 18 age group, and at the second molar in the 14 to 15 age group. The hypodivergent facial type had greater labiolingual bone inclination at the central incisor region. The difference in bone inclination at the central incisor region correlates with the tooth inclination found in the different facial types. In general, the hypodivergent facial type had more upright posterior alveolar bone in the 14 to 15 age group and the 16 to 18 age group. These findings correlate with the more upright buccolingual teeth inclinations in these two age groups. As mandibular posterior teeth of hypodivergent subjects endure greater masticatory pressure due to stronger muscle forces, posterior mandibular teeth are more upright and the alveolar bone subsequently uprights as well (Tsunori et al., 1998). It is interesting to note that in the 12 to 13 age group, the alveolar bone was more lingually inclined in the posterior and anterior mandible than in the hypodivergent facial type. Perhaps this is due to the fact that after teeth have erupted into the arch, posteruptive movements that accommodate the growth of the jaws generally occurs between the ages of 14 and 18 years and this in turned influenced alveolar bone inclinations (Nanci, 2008). In addition, it has been found that masticatory activity increases with age (Pancherz, 1980). The increased bite force in the older hypodivergent subjects may have contributed to the compensation of the diverged and upright alveolar bone in the older subjects. In conclusion, in general the mandibular alveolar bone inclination followed the same angulation tendency as the tooth inclination.

Limitations and Future Studies

The majority of the past studies evaluating mandibular morphology in relation to facial types have utilized lateral cephalograms or CT scans. Lateral cephalograms have the disadvantages of magnification, distortion, and superimposition of structures and CT scans have the disadvantage of compromises in precision of measurements due to anisotropic voxels (Mah et al., 2003). The use of CBCT has the benefit of accurate, reliable, and high definition images but there are compromises in the precision of measurements when the thickness of the alveolar bone is below or near the voxel size because the voxel will reflect an average density of the alveolar bone and periodontal ligament rather than the true density of the alveolar bone (Sun et al., 2011). The border voxel in this study had a 376-micron width, which could potentially include the contribution of more than one tissue. With cortical bone thickness measurements ranging from 1.27mm to 3.76mm, the error could range from 10.0% (376/3760) to 29.6% (376/1270) in the worst case scenario. With alveolar bone height measurements ranging from 21.29 mm to 31.62 mm, the error could range from 1.2% (376/31,620) to 1.8% (376/21,290) in the worst case scenario. With alveolar bone width measurements ranging from 6.38mm and 15.36mm, the error could range from 2.4% (376/15,360) to 5.9% (376/6380) in the worst case scenario. These error calculations followed the same computation method used in the study by Swasty et al. (2011). Despite the potential for some loss of precision, especially in areas of thin cortical bone, the measurements were conducted consistently in this study and the same criteria was used for all measurements which eliminated uncertainties in determining the thickest and thinnest regions of the cortical bone. Cortical bone measurements were also within the same range as studies which used physical calipers on cadavers (Schwartz-Dabney & Dechow, 2003).

CBCT can be reliably used in the current study of mandibular alveolar morphology of adolescents because the majority of measurements were concentrated in areas of the mandible with greater cortical bone thickness. The cortical bone measurements in the posterior mandible collected in this research project were generally 5 to 10 times greater than the 0.38 mm voxel-size scans used. Mandibular anterior cortical bone measurements collected in this study were generally 3 to 8 times greater than that of the 0.38 mm voxel size, which decreased the chance of underestimation of cortical bone thickness. Results of past research have demonstrated that measurements with CBCT are accurate and repeatable (Damstra et al., 2010; Kobayashi et al, 2004; Timock et al., 2011). Although there is some possible loss of accuracy in areas of thin cortical bone, the measurements in this study can still be predictably relied upon as the majority of the sites measured contained cortical bone of a few millimeters. Future studies utilizing smaller voxel size CBCT scans can help improve the accuracy of the measurements.

The second limitation to this study involved the limited sample size in the subdivided age groups. When the total sample size of 30 hypodivergent subjects is separated, there remain only 11 short-faced individuals in the 12 to 13 age group, 12 short-faced individuals in the 14 to 15 age group, and 7 short-faced individuals in the 16 to 18 age group. The 16 to 18 age group also had a limited total sample size of 33 subjects. The limited sample sizes means less statistical power and lower probability that true differences were actually detected. Future studies, then, should focus on studying a larger number of subjects in each age subgroup.

Subjects were limited to the patients in the dental records archive from UNLV School of Dental Medicine, which were not representative of the entire population at large. In addition, subjects of all ethnicities were included in the study and differences in craniofacial morphology may be present between the different groups. Future studies should focus on the adolescent population of a single ethnicity in order to eliminate any variances in mandibular morphology attributable to ethnic differences.

The adolescents in the study were divided into groups based upon chronological age. However, chronologic age does not always accurately reflect where an individual is developmentally. In order to identify an individual's true stage of development, a diagnosis of skeletal age is also needed. The conclusions for each age group may change once skeletal age is also accounted for. Future studies on differences in facial types in the adolescent group should take into account of skeletal age along with the chronologic age.

Conclusion

This study used the improved imaging capability of the CBCT to investigate the relationship between vertical facial patterns and mandibular tooth-alveolar morphology in the adolescent population. Overall, statistically significant differences were found between the facial types for all categories measured, including cortical bone thickness, alveolar bone height, alveolar bone width, tooth inclination, and alveolar bone inclination. Cortical bone thickness was greatest in the hypodivergent group and least in the hyperdivergent group with statistically significant differences at the majority of sites measured in the mandible. In all adolescent age groups, the hyperdivergent group generally had the greatest alveolar bone height compared with the other facial types at the central incisor region and the shortest alveolar bone height at the second molar region. The hyperdivergent group generally had the narrowest alveolar bone width compared with the other two facial types with the narrowest width in the mandible at the upper $1/3^{rd}$ of the alveolar bone in the central incisor region. The hyperdivergent group had the smallest labiolingual inclination of the central incisor and more lingually inclined posterior teeth than the hyperdivergent and normodivergent groups. The mandibular alveolar bone inclination followed the same angulation tendency as the tooth inclination.

The same conclusions regarding tooth-alveolar morphology differences between the facial types for the 12 to 18 age group applied to the subdivided age groups as well. The main difference noted with the individual age groups was that the number of statistically significant sites increased or decreased depending on the chronological age of the subjects. The number of statistically significant sites in cortical bone thickness increased immediately after the adolescent growth spurt in the 14 to 15 age group and decreased in the 16 to 18 age group as incremental growth rates decreased and subjects began to reach adult size. Mean posterior bone width differences between the facial types also decreased from the younger 12 to 13 age group to the older 14 to 15 and 16 to 18 age group. Large differences in width between the facial types remained, however, in the anterior mandible despite changes with age. No statistically significant differences in tooth inclination were found in the 12 to 13 age group. However, in the older subjects studied, tooth position had stabilized and statistically significant differences in tooth inclination between the facial types were noted, especially at the central incisor.

Orthodontic treatment planning and mechanics are affected by differences in mandibular tooth alveolar morphology and therefore significant benefit can be gained from understanding the mandibular anatomy variances between the facial types. The results of this study give further clarification of the distinctions between the facial divergences in the adolescent population. Further research with a larger adolescent sample size in each age subgroup will be beneficial in providing further clarification and substantiation of the changes associated with growth found in this study.

Appendix A: UNLV Institutional Review Board Approval

UNLV

Biomedical IRB

Notice of Excluded Activity

DATE:	November 24, 2014
TO:	**Dr. James Mah,** School of Dental Medicine
FROM:	Office of Research Integrity – Human Subjects
RE:	Notification of IRB Action Protocol Title: **Mandibular Morphology Analysis of Archival Dental Records** Protocol# 1411-4992M

This memorandum is notification that the project referenced above has been reviewed as indicated in Federal regulatory statutes 45CFR46.

The protocol has been reviewed and deemed excluded from IRB review. It is not in need of further review or approval by the IRB.

Any changes to the excluded activity may cause this project to require a different level of IRB review. Should any changes need to be made, please submit a Modification Form.

If you have questions or require any assistance, please contact the Office of Research Integrity – Human Subjects at IRB@unlv.edu or call 702-895-2794.

Office of Research Integrity – Human Subjects
4505 Maryland Parkway • Box 451047 • Las Vegas, Nevada 89154-1047
(702) 895-2794 • FAX: (702) 895-0805 • IRB@unlv.edu

Appendix B: Shapiro Wilk and Levene's Test

Age 12 to 18 Years (Shapiro Wilk)

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	FaceTyp	Statistic	df	Sig.	Statistic	df	Sig.
CBB132M	Normodivergent	.053	82	.200*	.986	82	.515
	Hypodivergent	.093	30	.200*	.977	30	.735
	Hyperdivergent	.073	61	.200*	.990	61	.911
CBB232M	Normodivergent	.063	82	.200*	.984	82	.400
	Hypodivergent	.059	30	.200*	.982	30	.871
	Hyperdivergent	.081	61	.200*	.971	61	.163
CLB132M	Normodivergent	.044	82	.200*	.992	82	.875
	Hypodivergent	.132	30	.195	.942	30	.103
	Hyperdivergent	.071	61	.200*	.990	61	.918
CLB232M	Normodivergent	.085	82	.200*	.970	82	.055
	Hypodivergent	.087	30	.200*	.989	30	.985
	Hyperdivergent	.085	61	.200*	.979	61	.389
BB2M	Normodivergent	.082	82	.200*	.976	82	.133
	Hypodivergent	.155	30	.064	.892	30	.005
	Hyperdivergent	.113	61	.052	.945	61	.009
BHT2M	Normodivergent	.113	82	.012	.956	82	.006
	Hypodivergent	.101	30	.200*	.973	30	.632
	Hyperdivergent	.077	61	.200*	.970	61	.142
BW132M	Normodivergent	.090	82	.099	.977	82	.149
	Hypodivergent	.105	30	.200*	.979	30	.797
	Hyperdivergent	.091	61	.200*	.979	61	.374
BW232M	Normodivergent	.088	82	.176	.983	82	.356
	Hypodivergent	.110	30	.200*	.958	30	.277
	Hyperdivergent	.066	61	.200*	.987	61	.750
TIncl2M	Normodivergent	.057	82	.200*	.991	82	.857
	Hypodivergent	.108	30	.200*	.979	30	.789
	Hyperdivergent	.069	61	.200*	.978	61	.352
BIncl2M	Normodivergent	.063	82	.200*	.993	82	.955
	Hypodivergent	.104	30	.200*	.970	30	.538
	Hyperdivergent	.083	61	.200*	.951	61	.015
CBB131M	Normodivergent	.081	82	.200*	.986	82	.489
	Hypodivergent	.102	30	.200*	.958	30	.282
	Hyperdivergent	.083	61	.200*	.983	61	.581
CBB231M	Normodivergent	.048	82	.200*	.983	82	.343
	Hypodivergent	.083	30	.200*	.971	30	.572
	Hyperdivergent	.079	61	.200*	.986	61	.693
CLB131M	Normodivergent	.064	82	.200*	.975	82	.108
	Hypodivergent	.105	30	.200*	.956	30	.245
	Hyperdivergent	.089	61	.200*	.980	61	.425
CLB231M	Normodivergent	.079	82	.200*	.986	82	.509
	Hypodivergent	.159	30	.052	.939	30	.087
	Hyperdivergent	.066	61	.200*	.972	61	.182
BB1M	Normodivergent	.075	82	.200*	.979	82	.205
	Hypodivergent	.098	30	.200*	.973	30	.622
	Hyperdivergent	.075	61	.200*	.972	61	.185
BHT1M	Normodivergent	.072	82	.200*	.985	82	.474
	Hypodivergent	.092	30	.200*	.966	30	.438

	Hyperdivergent	.093	61	.200*	.964	61	.072
BW131M	Normodivergent	.048	82	.200*	.992	82	.872
	Hypodivergent	.082	30	.200*	.987	30	.969
	Hyperdivergent	.078	61	.200*	.973	61	.191
BW231M	Normodivergent	.095	82	.066	.979	82	.208
	Hypodivergent	.109	30	.200*	.963	30	.373
	Hyperdivergent	.062	61	.200*	.977	61	.318
TIncl1M	Normodivergent	.071	82	.200*	.985	82	.452
	Hypodivergent	.149	30	.089	.928	30	.043
	Hyperdivergent	.097	61	.200*	.976	61	.271
BIncl1M	Normodivergent	.063	82	.200*	.979	82	.195
	Hypodivergent	.171	30	.026	.947	30	.143
	Hyperdivergent	.089	61	.200*	.977	61	.303
CBB132P	Normodivergent	.090	82	.100	.987	82	.553
	Hypodivergent	.144	30	.115	.941	30	.094
	Hyperdivergent	.089	61	.200*	.968	61	.108
CBB232P	Normodivergent	.054	82	.200*	.987	82	.587
	Hypodivergent	.095	30	.200*	.980	30	.814
	Hyperdivergent	.071	61	.200*	.986	61	.718
CLB132P	Normodivergent	.039	82	.200*	.988	82	.657
	Hypodivergent	.114	30	.200*	.966	30	.431
	Hyperdivergent	.081	61	.200*	.978	61	.355
CLB232P	Normodivergent	.102	82	.035	.968	82	.039
	Hypodivergent	.101	30	.200*	.951	30	.175
	Hyperdivergent	.098	61	.200*	.978	61	.325
BB2P	Normodivergent	.066	82	.200*	.990	82	.779
	Hypodivergent	.090	30	.200*	.983	30	.900
	Hyperdivergent	.095	61	.200*	.981	61	.447
BHT2P	Normodivergent	.115	82	.009	.975	82	.104
	Hypodivergent	.070	30	.200*	.985	30	.944
	Hyperdivergent	.086	61	.200*	.982	61	.526
BW132P	Normodivergent	.066	82	.200*	.990	82	.788
	Hypodivergent	.102	30	.200*	.954	30	.211
	Hyperdivergent	.078	61	.200*	.978	61	.353
BW232P	Normodivergent	.072	82	.200*	.976	82	.118
	Hypodivergent	.092	30	.200*	.966	30	.443
	Hyperdivergent	.088	61	.200*	.981	61	.479
TIncl2P	Normodivergent	.090	82	.154	.985	82	.474
	Hypodivergent	.114	30	.200*	.955	30	.233
	Hyperdivergent	.058	61	.200*	.968	61	.117
BIncl2P	Normodivergent	.055	82	.200*	.989	82	.683
	Hypodivergent	.133	30	.184	.939	30	.088
	Hyperdivergent	.095	61	.200*	.982	61	.497
CBB13CI	Normodivergent	.070	82	.200*	.968	82	.037
	Hypodivergent	.086	30	.200*	.974	30	.653
	Hyperdivergent	.077	61	.200*	.975	61	.252
CBB23CI	Normodivergent	.074	82	.200*	.975	82	.103
	Hypodivergent	.111	30	.200*	.974	30	.654
	Hyperdivergent	.079	61	.200*	.978	61	.344
CLB13CI	Normodivergent	.059	82	.200*	.991	82	.835
	Hypodivergent	.117	30	.200*	.936	30	.072
	Hyperdivergent	.080	61	.200*	.985	61	.680
CLB23CI	Normodivergent	.076	82	.200*	.980	82	.231
	Hypodivergent	.151	30	.078	.897	30	.007
	Hyperdivergent	.145	61	.003	.943	61	.007
BBCI	Normodivergent	.104	82	.029	.940	82	.001
	Hypodivergent	.083	30	.200*	.984	30	.928

	Hyperdivergent	.069	61	.200*	.977	61	.290
BHTCI	Normodivergent	.073	82	.200*	.985	82	.467
	Hypodivergent	.107	30	.200*	.980	30	.838
	Hyperdivergent	.078	61	.200*	.981	61	.457
BW13CI	Normodivergent	.061	82	.200*	.991	82	.854
	Hypodivergent	.097	30	.200*	.963	30	.372
	Hyperdivergent	.087	61	.200*	.987	61	.789
BW23CI	Normodivergent	.083	82	.200*	.969	82	.044
	Hypodivergent	.112	30	.200*	.953	30	.207
	Hyperdivergent	.087	61	.200*	.976	61	.286
TInclCI	Normodivergent	.051	82	.200*	.988	82	.674
	Hypodivergent	.130	30	.200*	.951	30	.184
	Hyperdivergent	.059	61	.200*	.989	61	.862
BInclCI	Normodivergent	.066	82	.200*	.988	82	.681
	Hypodivergent	.098	30	.200*	.943	30	.108
	Hyperdivergent	.066	61	.200*	.988	61	.796

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Age 12 to 18 Years (Levene's Test)

Test of Homogeneity of Variances

	Levene Statistic	df1	df2	Sig.
CBB132M	.334	2	170	.717
CBB232M	.822	2	170	.441
CLB132M	.860	2	170	.425
CLB232M	1.185	2	170	.308
BB2M	1.979	2	170	.141
BHT2M	.662	2	170	.517
BW132M	.628	2	170	.535
BW232M	.525	2	170	.593
TIncl2M	.328	2	170	.721
BIncl2M	1.736	2	170	.179
CBB131M	.160	2	170	.853
CBB231M	2.896	2	170	.058
CLB131M	.074	2	170	.929
CLB231M	.721	2	170	.488
BB1M	1.054	2	170	.351
BHT1M	1.434	2	170	.241
BW131M	2.483	2	170	.087
BW231M	.393	2	170	.675
TIncl1M	1.642	2	170	.197
BIncl1M	.806	2	170	.448
CBB132P	2.086	2	170	.127
CBB232P	1.912	2	170	.151
CLB132P	.817	2	170	.443
CLB232P	2.158	2	170	.119
BB2P	.459	2	170	.633
BHT2P	2.511	2	170	.084
BW132P	.385	2	170	.681
BW232P	.532	2	170	.588
TIncl2P	.706	2	170	.495
BIncl2P	.829	2	170	.438

CBB13CI	1.091	2	170	.338
CBB23CI	.003	2	170	.997
CLB13CI	2.953	2	170	.055
CLB23CI	.001	2	170	.999
BBCI	.233	2	170	.792
BHTCI	.260	2	170	.772
BW13CI	.052	2	170	.949
BW23CI	1.311	2	170	.272
TInclCI	.703	2	170	.497
BInclCI	2.316	2	170	.102

Age 12 to 13 Years (Shapiro Wilk)

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	FaceTyp	Statistic	df	Sig.	Statistic	df	Sig.
CBB132M	Normodivergent	.140	35	.081	.964	35	.298
	Hypodivergent	.121	11	.200*	.965	11	.836
	Hyperdivergent	.146	19	.200*	.973	19	.833
CBB232M	Normodivergent	.173	35	.010	.925	35	.020
	Hypodivergent	.215	11	.164	.943	11	.552
	Hyperdivergent	.154	19	.200*	.901	19	.050
CLB132M	Normodivergent	.096	35	.200*	.974	35	.556
	Hypodivergent	.199	11	.200*	.950	11	.642
	Hyperdivergent	.149	19	.200*	.951	19	.416
CLB232M	Normodivergent	.101	35	.200*	.956	35	.173
	Hypodivergent	.110	11	.200*	.962	11	.801
	Hyperdivergent	.130	19	.200*	.961	19	.602
BB2M	Normodivergent	.098	35	.200*	.968	35	.391
	Hypodivergent	.310	11	.004	.759	11	.003
	Hyperdivergent	.114	19	.200*	.983	19	.968
BHT2M	Normodivergent	.088	35	.200*	.977	35	.650
	Hypodivergent	.161	11	.200*	.897	11	.171
	Hyperdivergent	.209	19	.028	.900	19	.048
BW132M	Normodivergent	.141	35	.077	.960	35	.222
	Hypodivergent	.190	11	.200*	.955	11	.713
	Hyperdivergent	.136	19	.200*	.943	19	.295
BW232M	Normodivergent	.123	35	.198	.962	35	.263
	Hypodivergent	.125	11	.200*	.991	11	.998
	Hyperdivergent	.170	19	.153	.942	19	.287
TIncl2M	Normodivergent	.118	35	.200*	.982	35	.808
	Hypodivergent	.173	11	.200*	.963	11	.814
	Hyperdivergent	.123	19	.200*	.956	19	.501
BIncl2M	Normodivergent	.099	35	.200*	.981	35	.779
	Hypodivergent	.231	11	.104	.879	11	.100
	Hyperdivergent	.090	19	.200*	.976	19	.888
CBB131M	Normodivergent	.125	35	.180	.960	35	.230
	Hypodivergent	.169	11	.200*	.923	11	.344
	Hyperdivergent	.105	19	.200*	.961	19	.589
CBB231M	Normodivergent	.106	35	.200*	.956	35	.175
	Hypodivergent	.169	11	.200*	.967	11	.858
	Hyperdivergent	.137	19	.200*	.963	19	.631
CLB131M	Normodivergent	.102	35	.200*	.952	35	.130
	Hypodivergent	.168	11	.200*	.926	11	.371
	Hyperdivergent	.114	19	.200*	.966	19	.687

CLB231M	Normodivergent	.102	35	.200*	.977	35	.649
	Hypodivergent	.215	11	.164	.774	11	.004
	Hyperdivergent	.069	19	.200*	.983	19	.973
BB1M	Normodivergent	.128	35	.158	.951	35	.121
	Hypodivergent	.164	11	.200*	.931	11	.419
	Hyperdivergent	.087	19	.200*	.954	19	.459
BHT1M	Normodivergent	.125	35	.185	.981	35	.803
	Hypodivergent	.181	11	.200*	.963	11	.814
	Hyperdivergent	.195	19	.055	.896	19	.042
BW131M	Normodivergent	.091	35	.200*	.977	35	.646
	Hypodivergent	.169	11	.200*	.947	11	.608
	Hyperdivergent	.112	19	.200*	.966	19	.702
BW231M	Normodivergent	.138	35	.092	.942	35	.063
	Hypodivergent	.199	11	.200*	.897	11	.168
	Hyperdivergent	.183	19	.094	.918	19	.105
TIncl1M	Normodivergent	.103	35	.200*	.979	35	.740
	Hypodivergent	.154	11	.200*	.957	11	.728
	Hyperdivergent	.166	19	.180	.948	19	.371
BIncl1M	Normodivergent	.140	35	.079	.947	35	.090
	Hypodivergent	.161	11	.200*	.945	11	.578
	Hyperdivergent	.111	19	.200*	.957	19	.521
CBB132P	Normodivergent	.153	35	.037	.940	35	.054
	Hypodivergent	.316	11	.003	.808	11	.012
	Hyperdivergent	.138	19	.200*	.925	19	.139
CBB232P	Normodivergent	.131	35	.138	.956	35	.177
	Hypodivergent	.162	11	.200*	.939	11	.506
	Hyperdivergent	.111	19	.200*	.964	19	.645
CLB132P	Normodivergent	.119	35	.200*	.972	35	.515
	Hypodivergent	.267	11	.027	.856	11	.051
	Hyperdivergent	.109	19	.200*	.962	19	.613
CLB232P	Normodivergent	.127	35	.163	.964	35	.296
	Hypodivergent	.184	11	.200*	.862	11	.061
	Hyperdivergent	.132	19	.200*	.948	19	.359
BB2P	Normodivergent	.097	35	.200*	.978	35	.691
	Hypodivergent	.147	11	.200*	.949	11	.635
	Hyperdivergent	.150	19	.200*	.973	19	.844
BHT2P	Normodivergent	.068	35	.200*	.986	35	.931
	Hypodivergent	.140	11	.200*	.975	11	.931
	Hyperdivergent	.164	19	.196	.932	19	.187
BW132P	Normodivergent	.065	35	.200*	.983	35	.841
	Hypodivergent	.197	11	.200*	.905	11	.213
	Hyperdivergent	.133	19	.200*	.968	19	.735
BW232P	Normodivergent	.103	35	.200*	.965	35	.322
	Hypodivergent	.166	11	.200*	.943	11	.556
	Hyperdivergent	.105	19	.200*	.983	19	.969
TIncl2P	Normodivergent	.102	35	.200*	.977	35	.649
	Hypodivergent	.122	11	.200*	.974	11	.926
	Hyperdivergent	.202	19	.040	.876	19	.018
BIncl2P	Normodivergent	.128	35	.159	.949	35	.109
	Hypodivergent	.157	11	.200*	.929	11	.397
	Hyperdivergent	.138	19	.200*	.945	19	.320
CBB13CI	Normodivergent	.097	35	.200*	.934	35	.036
	Hypodivergent	.185	11	.200*	.931	11	.424
	Hyperdivergent	.123	19	.200*	.972	19	.808
CBB23CI	Normodivergent	.123	35	.196	.942	35	.064
	Hypodivergent	.199	11	.200*	.945	11	.586
	Hyperdivergent	.260	19	.001	.882	19	.023

CLB13CI	Normodivergent	.090	35	.200*	.985	35	.901
	Hypodivergent	.168	11	.200*	.914	11	.274
	Hyperdivergent	.119	19	.200*	.965	19	.670
CLB23CI	Normodivergent	.097	35	.200*	.969	35	.420
	Hypodivergent	.225	11	.125	.873	11	.083
	Hyperdivergent	.178	19	.114	.907	19	.067
BBCI	Normodivergent	.174	35	.009	.798	35	.000
	Hypodivergent	.181	11	.200*	.925	11	.359
	Hyperdivergent	.114	19	.200*	.960	19	.567
BHTCI	Normodivergent	.090	35	.200*	.969	35	.413
	Hypodivergent	.203	11	.200*	.892	11	.146
	Hyperdivergent	.114	19	.200*	.955	19	.485
BW13CI	Normodivergent	.111	35	.200*	.969	35	.407
	Hypodivergent	.124	11	.200*	.975	11	.933
	Hyperdivergent	.124	19	.200*	.948	19	.367
BW23CI	Normodivergent	.124	35	.195	.946	35	.087
	Hypodivergent	.168	11	.200*	.979	11	.962
	Hyperdivergent	.136	19	.200*	.914	19	.089
TInclCI	Normodivergent	.098	35	.200*	.968	35	.392
	Hypodivergent	.196	11	.200*	.950	11	.647
	Hyperdivergent	.134	19	.200*	.970	19	.770
BInclCI	Normodivergent	.109	35	.200*	.972	35	.497
	Hypodivergent	.133	11	.200*	.972	11	.910
	Hyperdivergent	.126	19	.200*	.974	19	.855

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

Age 12 to 13 Years (Levene's Test)

Test of Homogeneity of Variances

	Levene Statistic	df1	df2	Sig.
CBB132M	.063	2	62	.939
CBB232M	.206	2	62	.814
CLB132M	.156	2	62	.856
CLB232M	.114	2	62	.893
BB2M	2.951	2	62	.060
BHT2M	.303	2	62	.740
BW132M	3.548	2	62	.035
BW232M	2.370	2	62	.102
TIncl2M	.106	2	62	.900
BIncl2M	.731	2	62	.486
CBB131M	.117	2	62	.890
CBB231M	.469	2	62	.628
CLB131M	.625	2	62	.539
CLB231M	.849	2	62	.433
BB1M	2.124	2	62	.128
BHT1M	.234	2	62	.792
BW131M	1.027	2	62	.364
BW231M	1.888	2	62	.160
TIncl1M	3.151	2	62	.051
BIncl1M	.007	2	62	.993
CBB132P	.900	2	62	.412
CBB232P	1.664	2	62	.198
CLB132P	.907	2	62	.409
CLB232P	5.913	2	62	.004
BB2P	.341	2	62	.713
BHT2P	.057	2	62	.944

BW132P	.218	2	62	.804
BW232P	1.263	2	62	.290
TIncl2P	.072	2	62	.930
BIncl2P	.129	2	62	.880
CBB13CI	.258	2	62	.773
CBB23CI	.124	2	62	.883
CLB13CI	2.153	2	62	.125
CLB23CI	1.941	2	62	.152
BBCI	1.417	2	62	.250
BHTCI	3.154	2	62	.050
BW13CI	1.230	2	62	.299
BW23CI	1.023	2	62	.365
TInclCI	.836	2	62	.438
BInclCI	1.010	2	62	.370

Age 14 to 15 Years (Shapiro-Wilk)

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	FaceTyp	Statistic	df	Sig.	Statistic	df	Sig.
CBB132M	Normodivergent	.082	38	.200*	.979	38	.687
	Hypodivergent	.141	12	.200*	.975	12	.957
	Hyperdivergent	.119	25	.200*	.932	25	.097
CBB232M	Normodivergent	.098	38	.200*	.974	38	.520
	Hypodivergent	.148	12	.200*	.946	12	.574
	Hyperdivergent	.077	25	.200*	.980	25	.891
CLB132M	Normodivergent	.098	38	.200*	.973	38	.474
	Hypodivergent	.177	12	.200*	.877	12	.081
	Hyperdivergent	.110	25	.200*	.970	25	.655
CLB232M	Normodivergent	.119	38	.191	.945	38	.060
	Hypodivergent	.178	12	.200*	.932	12	.402
	Hyperdivergent	.083	25	.200*	.965	25	.531
BB2M	Normodivergent	.087	38	.200*	.976	38	.589
	Hypodivergent	.135	12	.200*	.940	12	.495
	Hyperdivergent	.145	25	.187	.926	25	.072
BHT2M	Normodivergent	.188	38	.002	.897	38	.002
	Hypodivergent	.239	12	.057	.942	12	.527
	Hyperdivergent	.150	25	.151	.941	25	.152
BW132M	Normodivergent	.127	38	.125	.964	38	.263
	Hypodivergent	.129	12	.200*	.967	12	.874
	Hyperdivergent	.069	25	.200*	.990	25	.995
BW232M	Normodivergent	.108	38	.200*	.974	38	.499
	Hypodivergent	.116	12	.200*	.961	12	.803
	Hyperdivergent	.115	25	.200*	.970	25	.647
TIncl2M	Normodivergent	.086	38	.200*	.973	38	.471
	Hypodivergent	.159	12	.200*	.969	12	.904
	Hyperdivergent	.107	25	.200*	.974	25	.744
BIncl2M	Normodivergent	.079	38	.200*	.976	38	.572
	Hypodivergent	.217	12	.123	.919	12	.281
	Hyperdivergent	.160	25	.099	.926	25	.070
CBB131M	Normodivergent	.092	38	.200*	.974	38	.499
	Hypodivergent	.138	12	.200*	.950	12	.642
	Hyperdivergent	.103	25	.200*	.984	25	.955
CBB231M	Normodivergent	.091	38	.200*	.978	38	.635

	Hypodivergent	.179	12	.200*	.928	12	.362
	Hyperdivergent	.148	25	.167	.953	25	.290
CLB131M	Normodivergent	.105	38	.200*	.964	38	.262
	Hypodivergent	.167	12	.200*	.965	12	.855
	Hyperdivergent	.129	25	.200*	.943	25	.173
CLB231M	Normodivergent	.105	38	.200*	.969	38	.377
	Hypodivergent	.231	12	.078	.886	12	.105
	Hyperdivergent	.110	25	.200*	.958	25	.381
BB1M	Normodivergent	.116	38	.200*	.972	38	.446
	Hypodivergent	.158	12	.200*	.918	12	.273
	Hyperdivergent	.107	25	.200*	.966	25	.545
BHT1M	Normodivergent	.090	38	.200*	.961	38	.208
	Hypodivergent	.119	12	.200*	.965	12	.851
	Hyperdivergent	.133	25	.200*	.941	25	.153
BW131M	Normodivergent	.084	38	.200*	.990	38	.980
	Hypodivergent	.131	12	.200*	.975	12	.953
	Hyperdivergent	.163	25	.084	.935	25	.115
BW231M	Normodivergent	.071	38	.200*	.981	38	.768
	Hypodivergent	.140	12	.200*	.943	12	.533
	Hyperdivergent	.168	25	.066	.937	25	.126
TIncl1M	Normodivergent	.119	38	.193	.976	38	.568
	Hypodivergent	.173	12	.200*	.929	12	.365
	Hyperdivergent	.101	25	.200*	.974	25	.745
BIncl1M	Normodivergent	.114	38	.200*	.926	38	.016
	Hypodivergent	.237	12	.062	.850	12	.037
	Hyperdivergent	.149	25	.159	.946	25	.205
CBB132P	Normodivergent	.108	38	.200*	.970	38	.389
	Hypodivergent	.163	12	.200*	.892	12	.124
	Hyperdivergent	.180	25	.037	.942	25	.168
CBB232P	Normodivergent	.092	38	.200*	.981	38	.768
	Hypodivergent	.204	12	.179	.960	12	.780
	Hyperdivergent	.135	25	.200*	.967	25	.572
CLB132P	Normodivergent	.092	38	.200*	.959	38	.174
	Hypodivergent	.166	12	.200*	.904	12	.177
	Hyperdivergent	.137	25	.200*	.973	25	.726
CLB232P	Normodivergent	.135	38	.079	.976	38	.587
	Hypodivergent	.133	12	.200*	.972	12	.933
	Hyperdivergent	.127	25	.200*	.960	25	.417
BB2P	Normodivergent	.127	38	.125	.972	38	.446
	Hypodivergent	.166	12	.200*	.931	12	.396
	Hyperdivergent	.192	25	.018	.926	25	.069
BHT2P	Normodivergent	.204	38	.000	.886	38	.001
	Hypodivergent	.132	12	.200*	.968	12	.890
	Hyperdivergent	.166	25	.076	.953	25	.291
BW132P	Normodivergent	.112	38	.200*	.972	38	.456
	Hypodivergent	.120	12	.200*	.948	12	.602
	Hyperdivergent	.105	25	.200*	.970	25	.633
BW232P	Normodivergent	.062	38	.200*	.977	38	.607
	Hypodivergent	.208	12	.162	.890	12	.117
	Hyperdivergent	.162	25	.090	.954	25	.310
TIncl2P	Normodivergent	.116	38	.200*	.975	38	.549
	Hypodivergent	.102	12	.200*	.942	12	.528
	Hyperdivergent	.103	25	.200*	.975	25	.762
BIncl2P	Normodivergent	.102	38	.200*	.955	38	.128
	Hypodivergent	.208	12	.159	.869	12	.063
	Hyperdivergent	.170	25	.061	.955	25	.332
CBB13CI	Normodivergent	.126	38	.133	.959	38	.178

	Hypodivergent	.114	12	.200*	.989	12	.999
	Hyperdivergent	.091	25	.200*	.963	25	.480
CBB23CI	Normodivergent	.094	38	.200*	.963	38	.240
	Hypodivergent	.199	12	.200*	.896	12	.141
	Hyperdivergent	.135	25	.200*	.962	25	.449
CLB13CI	Normodivergent	.119	38	.189	.976	38	.568
	Hypodivergent	.137	12	.200*	.979	12	.979
	Hyperdivergent	.100	25	.200*	.970	25	.647
CLB23CI	Normodivergent	.083	38	.200*	.986	38	.913
	Hypodivergent	.140	12	.200*	.945	12	.567
	Hyperdivergent	.185	25	.027	.933	25	.101
BBCI	Normodivergent	.115	38	.200*	.969	38	.370
	Hypodivergent	.140	12	.200*	.969	12	.905
	Hyperdivergent	.092	25	.200*	.978	25	.832
BHTCI	Normodivergent	.088	38	.200*	.981	38	.736
	Hypodivergent	.152	12	.200*	.978	12	.973
	Hyperdivergent	.112	25	.200*	.964	25	.503
BW13CI	Normodivergent	.097	38	.200*	.967	38	.319
	Hypodivergent	.135	12	.200*	.955	12	.712
	Hyperdivergent	.123	25	.200*	.970	25	.636
BW23CI	Normodivergent	.074	38	.200*	.980	38	.730
	Hypodivergent	.179	12	.200*	.879	12	.084
	Hyperdivergent	.107	25	.200*	.977	25	.815
TInclCI	Normodivergent	.067	38	.200*	.986	38	.906
	Hypodivergent	.152	12	.200*	.972	12	.933
	Hyperdivergent	.149	25	.160	.932	25	.096
BInclCI	Normodivergent	.051	38	.200*	.989	38	.961
	Hypodivergent	.175	12	.200*	.904	12	.177
	Hyperdivergent	.096	25	.200*	.979	25	.875

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Age 14 to 15 Years (Levene's Test)

Homogeneity of Variances

	Levene Statistic	df1	df2	Sig.
CBB132M	.513	2	72	.601
CBB232M	.038	2	72	.963
CLB132M	2.542	2	72	.086
CLB232M	.995	2	72	.375
BB2M	1.218	2	72	.302
BHT2M	.042	2	72	.959
BW132M	.566	2	72	.570
BW232M	1.052	2	72	.354
TIncl2M	.689	2	72	.505
BIncl2M	.738	2	72	.482
CBB131M	1.239	2	72	.296
CBB231M	1.432	2	72	.246
CLB131M	.144	2	72	.866
CLB231M	.571	2	72	.568
BB1M	.887	2	72	.416
BHT1M	.826	2	72	.442
BW131M	.885	2	72	.417

BW231M	1.182	2	72	.312
TIncl1M	.777	2	72	.463
BIncl1M	.423	2	72	.657
CBB132P	1.410	2	72	.251
CBB232P	1.898	2	72	.157
CLB132P	.739	2	72	.481
CLB232P	.435	2	72	.649
BB2P	1.188	2	72	.311
BHT2P	.535	2	72	.588
BW132P	.771	2	72	.466
BW232P	1.398	2	72	.254
TIncl2P	.390	2	72	.679
BIncl2P	.221	2	72	.802
CBB13CI	.373	2	72	.690
CBB23CI	.179	2	72	.837
CLB13CI	2.672	2	72	.076
CLB23CI	.653	2	72	.524
BBCI	.002	2	72	.998
BHTCI	.716	2	72	.492
BW13CI	.717	2	72	.492
BW23CI	1.737	2	72	.183
TInclCI	.767	2	72	.468
BInclCI	1.182	2	72	.313

Age 16 to 18 Years (Shapiro-Wilk)

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	FaceTyp	Statistic	df	Sig.	Statistic	df	Sig.
CBB132M	Normodivergent	.160	9	.200*	.944	9	.621
	Hypodivergent	.255	7	.189	.855	7	.137
	Hyperdivergent	.134	17	.200*	.959	17	.611
CBB232M	Normodivergent	.149	9	.200*	.985	9	.984
	Hypodivergent	.223	7	.200*	.953	7	.757
	Hyperdivergent	.140	17	.200*	.954	17	.526
CLB132M	Normodivergent	.157	9	.200*	.942	9	.602
	Hypodivergent	.242	7	.200*	.865	7	.167
	Hyperdivergent	.139	17	.200*	.975	17	.896
CLB232M	Normodivergent	.153	9	.200*	.948	9	.667
	Hypodivergent	.211	7	.200*	.967	7	.878
	Hyperdivergent	.219	17	.030	.894	17	.054
BB2M	Normodivergent	.273	9	.052	.835	9	.050
	Hypodivergent	.283	7	.095	.805	7	.046
	Hyperdivergent	.114	17	.200*	.947	17	.411
BHT2M	Normodivergent	.155	9	.200*	.923	9	.418
	Hypodivergent	.140	7	.200*	.948	7	.712
	Hyperdivergent	.119	17	.200*	.962	17	.663
BW132M	Normodivergent	.238	9	.148	.861	9	.098
	Hypodivergent	.171	7	.200*	.896	7	.306
	Hyperdivergent	.184	17	.131	.911	17	.103
BW232M	Normodivergent	.187	9	.200*	.888	9	.191
	Hypodivergent	.223	7	.200*	.912	7	.410
	Hyperdivergent	.179	17	.149	.950	17	.454
TIncl2M	Normodivergent	.247	9	.122	.866	9	.111
	Hypodivergent	.172	7	.200*	.916	7	.443

	Hyperdivergent	.121	17	.200*	.967	17	.761
BIncl2M	Normodivergent	.180	9	.200*	.959	9	.792
	Hypodivergent	.150	7	.200*	.966	7	.865
	Hyperdivergent	.169	17	.200*	.920	17	.150
CBB131M	Normodivergent	.209	9	.200*	.931	9	.486
	Hypodivergent	.194	7	.200*	.869	7	.181
	Hyperdivergent	.149	17	.200*	.907	17	.089
CBB231M	Normodivergent	.209	9	.200*	.899	9	.248
	Hypodivergent	.274	7	.121	.822	7	.067
	Hyperdivergent	.149	17	.200*	.960	17	.635
CLB131M	Normodivergent	.198	9	.200*	.895	9	.224
	Hypodivergent	.264	7	.149	.836	7	.092
	Hyperdivergent	.119	17	.200*	.965	17	.733
CLB231M	Normodivergent	.224	9	.200*	.898	9	.242
	Hypodivergent	.229	7	.200*	.953	7	.756
	Hyperdivergent	.151	17	.200*	.955	17	.548
BB1M	Normodivergent	.158	9	.200*	.965	9	.852
	Hypodivergent	.228	7	.200*	.879	7	.220
	Hyperdivergent	.189	17	.107	.960	17	.627
BHT1M	Normodivergent	.234	9	.169	.941	9	.589
	Hypodivergent	.219	7	.200*	.887	7	.258
	Hyperdivergent	.088	17	.200*	.974	17	.887
BW131M	Normodivergent	.196	9	.200*	.957	9	.765
	Hypodivergent	.256	7	.181	.903	7	.348
	Hyperdivergent	.145	17	.200*	.929	17	.210
BW231M	Normodivergent	.175	9	.200*	.957	9	.766
	Hypodivergent	.265	7	.147	.905	7	.362
	Hyperdivergent	.143	17	.200*	.961	17	.659
TIncl1M	Normodivergent	.190	9	.200*	.905	9	.282
	Hypodivergent	.229	7	.200*	.880	7	.229
	Hyperdivergent	.097	17	.200*	.968	17	.785
BIncl1M	Normodivergent	.172	9	.200*	.955	9	.743
	Hypodivergent	.201	7	.200*	.947	7	.698
	Hyperdivergent	.125	17	.200*	.971	17	.837
CBB132P	Normodivergent	.233	9	.173	.906	9	.288
	Hypodivergent	.207	7	.200*	.899	7	.324
	Hyperdivergent	.189	17	.107	.908	17	.093
CBB232P	Normodivergent	.248	9	.118	.913	9	.341
	Hypodivergent	.218	7	.200*	.909	7	.392
	Hyperdivergent	.103	17	.200*	.970	17	.824
CLB132P	Normodivergent	.099	9	.200*	.993	9	.999
	Hypodivergent	.185	7	.200*	.957	7	.790
	Hyperdivergent	.106	17	.200*	.971	17	.831
CLB232P	Normodivergent	.133	9	.200*	.959	9	.787
	Hypodivergent	.184	7	.200*	.945	7	.688
	Hyperdivergent	.148	17	.200*	.931	17	.227
BB2P	Normodivergent	.254	9	.099	.908	9	.299
	Hypodivergent	.189	7	.200*	.975	7	.934
	Hyperdivergent	.133	17	.200*	.950	17	.462
BHT2P	Normodivergent	.171	9	.200*	.907	9	.297
	Hypodivergent	.219	7	.200*	.922	7	.486
	Hyperdivergent	.139	17	.200*	.972	17	.858
BW132P	Normodivergent	.170	9	.200*	.960	9	.798
	Hypodivergent	.210	7	.200*	.903	7	.350
	Hyperdivergent	.121	17	.200*	.955	17	.542
BW232P	Normodivergent	.227	9	.199	.900	9	.250
	Hypodivergent	.193	7	.200*	.907	7	.376

	Hyperdivergent	.156	17	.200*	.962	17	.660
TIncl2P	Normodivergent	.155	9	.200*	.975	9	.931
	Hypodivergent	.245	7	.200*	.866	7	.173
	Hyperdivergent	.139	17	.200*	.956	17	.554
BIncl2P	Normodivergent	.143	9	.200*	.966	9	.862
	Hypodivergent	.234	7	.200*	.879	7	.221
	Hyperdivergent	.115	17	.200*	.982	17	.971
CBB13CI	Normodivergent	.190	9	.200*	.933	9	.513
	Hypodivergent	.199	7	.200*	.891	7	.282
	Hyperdivergent	.158	17	.200*	.915	17	.121
CBB23CI	Normodivergent	.230	9	.187	.868	9	.116
	Hypodivergent	.292	7	.073	.845	7	.110
	Hyperdivergent	.132	17	.200*	.960	17	.637
CLB13CI	Normodivergent	.218	9	.200*	.904	9	.275
	Hypodivergent	.190	7	.200*	.915	7	.429
	Hyperdivergent	.143	17	.200*	.953	17	.512
CLB23CI	Normodivergent	.271	9	.055	.872	9	.128
	Hypodivergent	.192	7	.200*	.908	7	.380
	Hyperdivergent	.151	17	.200*	.961	17	.659
BBCI	Normodivergent	.175	9	.200*	.959	9	.783
	Hypodivergent	.212	7	.200*	.942	7	.657
	Hyperdivergent	.120	17	.200*	.962	17	.675
BHTCI	Normodivergent	.151	9	.200*	.933	9	.511
	Hypodivergent	.250	7	.200*	.926	7	.520
	Hyperdivergent	.110	17	.200*	.965	17	.724
BW13CI	Normodivergent	.125	9	.200*	.944	9	.622
	Hypodivergent	.241	7	.200*	.941	7	.648
	Hyperdivergent	.125	17	.200*	.968	17	.783
BW23CI	Normodivergent	.188	9	.200*	.911	9	.323
	Hypodivergent	.254	7	.190	.886	7	.253
	Hyperdivergent	.158	17	.200*	.925	17	.182
TInclCI	Normodivergent	.245	9	.128	.936	9	.545
	Hypodivergent	.290	7	.078	.917	7	.448
	Hyperdivergent	.121	17	.200*	.953	17	.502
BInclCI	Normodivergent	.277	9	.044	.866	9	.111
	Hypodivergent	.324	7	.025	.756	7	.015
	Hyperdivergent	.156	17	.200*	.945	17	.376

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

Age 16 to 18 Years (Levene's Test)

Test of Homogeneity of Variances

	Levene Statistic	df1	df2	Sig.
CBB132M	.476	2	30	.626
CBB232M	1.395	2	30	.263
CLB132M	.206	2	30	.815
CLB232M	.062	2	30	.940
BB2M	.077	2	30	.926
BHT2M	.052	2	30	.950
BW132M	1.492	2	30	.241
BW232M	.821	2	30	.450
TIncl2M	.284	2	30	.755
BIncl2M	1.094	2	30	.348
CBB131M	3.326	2	30	.050

CBB231M	3.416	2	30	.046
CLB131M	.594	2	30	.558
CLB231M	1.170	2	30	.324
BB1M	.969	2	30	.391
BHT1M	.468	2	30	.631
BW131M	2.820	2	30	.075
BW231M	1.439	2	30	.253
TIncl1M	1.286	2	30	.291
BIncl1M	.835	2	30	.444
CBB132P	.812	2	30	.454
CBB232P	1.495	2	30	.240
CLB132P	2.481	2	30	.101
CLB232P	.896	2	30	.419
BB2P	.369	2	30	.695
BHT2P	.597	2	30	.557
BW132P	2.025	2	30	.150
BW232P	.060	2	30	.941
TIncl2P	.965	2	30	.392
BIncl2P	1.799	2	30	.183
CBB13CI	1.858	2	30	.173
CBB23CI	.611	2	30	.549
CLB13CI	1.028	2	30	.370
CLB23CI	2.718	2	30	.082
BBCI	3.620	2	30	.039
BHTCI	.226	2	30	.799
BW13CI	.132	2	30	.877
BW23CI	1.948	2	30	.160
TInclCI	1.603	2	30	.218
BInclCI	1.678	2	30	.204

Appendix C: ANOVA and Posthoc Scheffé

Age 12 to 18 Years (ANOVA)

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
CBB132M	Between Groups	7.244	2	3.622	15.563	.000
	Within Groups	39.563	170	.233		
	Total	46.808	172			
CBB232M	Between Groups	3.475	2	1.737	8.275	.000
	Within Groups	35.691	170	.210		
	Total	39.166	172			
CLB132M	Between Groups	7.193	2	3.596	20.507	.000
	Within Groups	29.813	170	.175		
	Total	37.006	172			
CLB232M	Between Groups	4.037	2	2.018	15.846	.000
	Within Groups	21.654	170	.127		
	Total	25.691	172			
BB2M	Between Groups	1.282	2	.641	1.978	.142
	Within Groups	55.083	170	.324		
	Total	56.365	172			
BHT2M	Between Groups	36.428	2	18.214	3.970	.021
	Within Groups	780.004	170	4.588		
	Total	816.432	172			
BW132M	Between Groups	13.972	2	6.986	3.180	.044
	Within Groups	373.518	170	2.197		
	Total	387.490	172			
BW232M	Between Groups	8.061	2	4.031	2.288	.105
	Within Groups	299.542	170	1.762		
	Total	307.603	172			
TIncl2M	Between Groups	19.748	2	9.874	.218	.804
	Within Groups	7700.140	170	45.295		
	Total	7719.888	172			
BIncl2M	Between Groups	159.845	2	79.922	3.319	.039
	Within Groups	4093.907	170	24.082		
	Total	4253.752	172			
CBB131M	Between Groups	12.058	2	6.029	28.266	.000
	Within Groups	36.261	170	.213		
	Total	48.319	172			
CBB231M	Between Groups	5.406	2	2.703	16.900	.000
	Within Groups	27.190	170	.160		
	Total	32.596	172			
CLB131M	Between Groups	9.722	2	4.861	19.366	.000

	Within Groups	42.671	170	.251		
	Total	52.392	172			
CLB231M	Between Groups	3.830	2	1.915	14.128	.000
	Within Groups	23.044	170	.136		
	Total	26.874	172			
BB1M	Between Groups	.830	2	.415	1.154	.318
	Within Groups	61.130	170	.360		
	Total	61.960	172			
BHT1M	Between Groups	3.114	2	1.557	.231	.794
	Within Groups	1148.275	170	6.755		
	Total	1151.389	172			
BW131M	Between Groups	28.233	2	14.116	7.183	.001
	Within Groups	334.086	170	1.965		
	Total	362.319	172			
BW231M	Between Groups	9.980	2	4.990	2.095	.126
	Within Groups	404.918	170	2.382		
	Total	414.897	172			
TIncl1M	Between Groups	56.928	2	28.464	1.193	.306
	Within Groups	4056.403	170	23.861		
	Total	4113.331	172			
BIncl1M	Between Groups	10.260	2	5.130	.230	.795
	Within Groups	3788.786	170	22.287		
	Total	3799.047	172			
CBB132P	Between Groups	8.934	2	4.467	33.537	.000
	Within Groups	22.644	170	.133		
	Total	31.579	172			
CBB232P	Between Groups	3.823	2	1.912	17.504	.000
	Within Groups	18.565	170	.109		
	Total	22.388	172			
CLB132P	Between Groups	5.266	2	2.633	13.666	.000
	Within Groups	32.751	170	.193		
	Total	38.017	172			
CLB232P	Between Groups	3.156	2	1.578	11.381	.000
	Within Groups	23.572	170	.139		
	Total	26.728	172			
BB2P	Between Groups	2.398	2	1.199	2.580	.079
	Within Groups	78.993	170	.465		
	Total	81.391	172			
BHT2P	Between Groups	28.727	2	14.364	1.879	.156
	Within Groups	1299.858	170	7.646		
	Total	1328.585	172			
BW132P	Between Groups	44.664	2	22.332	9.311	.000
	Within Groups	407.749	170	2.399		
	Total	452.413	172			
BW232P	Between Groups	10.472	2	5.236	2.178	.116
	Within Groups	408.659	170	2.404		
	Total	419.131	172			

TIncl2P	Between Groups	450.680	2	225.340	6.256	.002
	Within Groups	6123.380	170	36.020		
	Total	6574.061	172			
BIncl2P	Between Groups	5.130	2	2.565	.141	.868
	Within Groups	3087.622	170	18.162		
	Total	3092.752	172			
CBB13CI	Between Groups	4.971	2	2.486	28.988	.000
	Within Groups	14.577	170	.086		
	Total	19.548	172			
CBB23CI	Between Groups	1.829	2	.914	7.008	.001
	Within Groups	22.183	170	.130		
	Total	24.012	172			
CLB13CI	Between Groups	3.060	2	1.530	10.289	.000
	Within Groups	25.275	170	.149		
	Total	28.334	172			
CLB23CI	Between Groups	13.028	2	6.514	11.784	.000
	Within Groups	93.973	170	.553		
	Total	107.001	172			
BBCI	Between Groups	7.148	2	3.574	7.207	.001
	Within Groups	84.306	170	.496		
	Total	91.454	172			
BHTCI	Between Groups	319.903	2	159.951	17.103	.000
	Within Groups	1589.861	170	9.352		
	Total	1909.764	172			
BW13CI	Between Groups	95.665	2	47.832	26.001	.000
	Within Groups	312.733	170	1.840		
	Total	408.398	172			
BW23CI	Between Groups	125.460	2	62.730	17.536	.000
	Within Groups	608.118	170	3.577		
	Total	733.578	172			
TInclCI	Between Groups	1337.749	2	668.874	12.597	.000
	Within Groups	9026.744	170	53.098		
	Total	10364.492	172			
BInclCI	Between Groups	181.240	2	90.620	2.643	.074
	Within Groups	5828.205	170	34.284		
	Total	6009.445	172			

Age 12 to 18 Years (Scheffé)

Multiple Comparisons

Scheffe

Dependent Variable	(I) FaceTyp	(J) FaceTyp	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound

CBB132M	Normodivergent	Hypodivergent	-.39699*	.10294	.001	-.6512	-.1428
		Hyperdivergent	.20314*	.08157	.048	.0017	.4046
	Hypodivergent	Normodivergent	.39699*	.10294	.001	.1428	.6512
		Hyperdivergent	.60014*	.10758	.000	.3345	.8658
	Hyperdivergent	Normodivergent	-.20314*	.08157	.048	-.4046	-.0017
		Hypodivergent	-.60014*	.10758	.000	-.8658	-.3345
CBB232M	Normodivergent	Hypodivergent	-.38679*	.09777	.001	-.6282	-.1454
		Hyperdivergent	-.03447	.07747	.906	-.2258	.1569
	Hypodivergent	Normodivergent	.38679*	.09777	.001	.1454	.6282
		Hyperdivergent	.35232*	.10218	.003	.1000	.6046
	Hyperdivergent	Normodivergent	.03447	.07747	.906	-.1569	.2258
		Hypodivergent	-.35232*	.10218	.003	-.6046	-.1000
CLB132M	Normodivergent	Hypodivergent	-.33005*	.08936	.001	-.5507	-.1094
		Hyperdivergent	.26023*	.07081	.002	.0854	.4351
	Hypodivergent	Normodivergent	.33005*	.08936	.001	.1094	.5507
		Hyperdivergent	.59028*	.09338	.000	.3597	.8209
	Hyperdivergent	Normodivergent	-.26023*	.07081	.002	-.4351	-.0854
		Hypodivergent	-.59028*	.09338	.000	-.8209	-.3597
CLB232M	Normodivergent	Hypodivergent	-.32511*	.07615	.000	-.5132	-.1370
		Hyperdivergent	.12133	.06034	.136	-.0277	.2704
	Hypodivergent	Normodivergent	.32511*	.07615	.000	.1370	.5132
		Hyperdivergent	.44644*	.07959	.000	.2499	.6430
	Hyperdivergent	Normodivergent	-.12133	.06034	.136	-.2704	.0277
		Hypodivergent	-.44644*	.07959	.000	-.6430	-.2499
BB2M	Normodivergent	Hypodivergent	-.23659	.12146	.153	-.5365	.0633
		Hyperdivergent	-.02703	.09625	.961	-.2647	.2107
	Hypodivergent	Normodivergent	.23659	.12146	.153	-.0633	.5365
		Hyperdivergent	.20957	.12693	.259	-.1039	.5230
	Hyperdivergent	Normodivergent	.02703	.09625	.961	-.2107	.2647
		Hypodivergent	-.20957	.12693	.259	-.5230	.1039
BHT2M	Normodivergent	Hypodivergent	-.54091	.45705	.498	-1.6696	.5878
		Hyperdivergent	.72672	.36218	.137	-.1677	1.6211
	Hypodivergent	Normodivergent	.54091	.45705	.498	-.5878	1.6696
		Hyperdivergent	1.26763*	.47766	.032	.0881	2.4472

	Hyperdivergent	Normodivergent	-.72672	.36218	.137	-1.6211	.1677
		Hypodivergent	-1.26763*	.47766	.032	-2.4472	-.0881
BW132M	Normodivergent	Hypodivergent	-.46824	.31628	.337	-1.2493	.3128
		Hyperdivergent	.35610	.25063	.367	-.2628	.9750
	Hypodivergent	Normodivergent	.46824	.31628	.337	-.3128	1.2493
		Hyperdivergent	.82433*	.33054	.047	.0081	1.6406
	Hyperdivergent	Normodivergent	-.35610	.25063	.367	-.9750	.2628
		Hypodivergent	-.82433*	.33054	.047	-1.6406	-.0081
BW232M	Normodivergent	Hypodivergent	-.59041	.28323	.117	-1.2899	.1090
		Hyperdivergent	-.25940	.22444	.514	-.8136	.2949
	Hypodivergent	Normodivergent	.59041	.28323	.117	-.1090	1.2899
		Hyperdivergent	.33102	.29601	.536	-.4000	1.0620
	Hyperdivergent	Normodivergent	.25940	.22444	.514	-.2949	.8136
		Hypodivergent	-.33102	.29601	.536	-1.0620	.4000
TIncl2M	Normodivergent	Hypodivergent	.3419	1.4360	.972	-3.204	3.888
		Hyperdivergent	.7512	1.1379	.804	-2.059	3.561
	Hypodivergent	Normodivergent	-.3419	1.4360	.972	-3.888	3.204
		Hyperdivergent	.4093	1.5008	.964	-3.297	4.115
	Hyperdivergent	Normodivergent	-.7512	1.1379	.804	-3.561	2.059
		Hypodivergent	-.4093	1.5008	.964	-4.115	3.297
BIncl2M	Normodivergent	Hypodivergent	-.7133	1.0471	.793	-3.299	1.872
		Hyperdivergent	1.7492	.8297	.112	-.300	3.798
	Hypodivergent	Normodivergent	.7133	1.0471	.793	-1.872	3.299
		Hyperdivergent	2.4625	1.0943	.083	-.240	5.165
	Hyperdivergent	Normodivergent	-1.7492	.8297	.112	-3.798	.300
		Hypodivergent	-2.4625	1.0943	.083	-5.165	.240
CBB131M	Normodivergent	Hypodivergent	-.56288*	.09854	.000	-.8062	-.3195
		Hyperdivergent	.20856*	.07809	.030	.0157	.4014
	Hypodivergent	Normodivergent	.56288*	.09854	.000	.3195	.8062
		Hyperdivergent	.77144*	.10299	.000	.5171	1.0258
	Hyperdivergent	Normodivergent	-.20856*	.07809	.030	-.4014	-.0157
		Hypodivergent	-.77144*	.10299	.000	-1.0258	-.5171
CBB231M	Normodivergent	Hypodivergent	-.41089*	.08533	.000	-.6216	-.2002
		Hyperdivergent	.09728	.06762	.358	-.0697	.2643
	Hypodivergent	Normodivergent	.41089*	.08533	.000	.2002	.6216

		Hyperdivergent	.50817*	.08918	.000	.2879	.7284
	Hyperdivergent	Normodivergent	-.09728	.06762	.358	-.2643	.0697
		Hypodivergent	-.50817*	.08918	.000	-.7284	-.2879
CLB131M	Normodivergent	Hypodivergent	-.51363*	.10690	.000	-.7776	-.2496
		Hyperdivergent	.17777	.08471	.114	-.0314	.3870
	Hypodivergent	Normodivergent	.51363*	.10690	.000	.2496	.7776
		Hyperdivergent	.69140*	.11172	.000	.4155	.9673
	Hyperdivergent	Normodivergent	-.17777	.08471	.114	-.3870	.0314
		Hypodivergent	-.69140*	.11172	.000	-.9673	-.4155
CLB231M	Normodivergent	Hypodivergent	-.26045*	.07856	.005	-.4544	-.0664
		Hyperdivergent	.17368*	.06225	.022	.0199	.3274
	Hypodivergent	Normodivergent	.26045*	.07856	.005	.0664	.4544
		Hyperdivergent	.43413*	.08210	.000	.2314	.6369
	Hyperdivergent	Normodivergent	-.17368*	.06225	.022	-.3274	-.0199
		Hypodivergent	-.43413*	.08210	.000	-.6369	-.2314
BB1M	Normodivergent	Hypodivergent	-.19073	.12795	.332	-.5067	.1252
		Hyperdivergent	-.02311	.10139	.974	-.2735	.2273
	Hypodivergent	Normodivergent	.19073	.12795	.332	-.1252	.5067
		Hyperdivergent	.16762	.13372	.457	-.1626	.4978
	Hyperdivergent	Normodivergent	.02311	.10139	.974	-.2273	.2735
		Hypodivergent	-.16762	.13372	.457	-.4978	.1626
BHT1M	Normodivergent	Hypodivergent	-.21400	.55455	.928	-1.5834	1.1554
		Hyperdivergent	-.28836	.43944	.807	-1.3735	.7968
	Hypodivergent	Normodivergent	.21400	.55455	.928	-1.1554	1.5834
		Hyperdivergent	-.07436	.57955	.992	-1.5056	1.3568
	Hyperdivergent	Normodivergent	.28836	.43944	.807	-.7968	1.3735
		Hypodivergent	.07436	.57955	.992	-1.3568	1.5056
BW131M	Normodivergent	Hypodivergent	-.66314	.29912	.089	-1.4018	.0755
		Hyperdivergent	.50818	.23703	.104	-.0772	1.0935
	Hypodivergent	Normodivergent	.66314	.29912	.089	-.0755	1.4018
		Hyperdivergent	1.17132*	.31261	.001	.3993	1.9433
	Hyperdivergent	Normodivergent	-.50818	.23703	.104	-1.0935	.0772
		Hypodivergent	-1.17132*	.31261	.001	-1.9433	-.3993
BW231M	Normodivergent	Hypodivergent	-.64807	.32931	.147	-1.4613	.1651
		Hyperdivergent	-.03535	.26095	.991	-.6798	.6091

	Hypodivergent	Normodivergent	.64807	.32931	.147	-.1651	1.4613
		Hyperdivergent	.61272	.34416	.208	-.2372	1.4626
	Hyperdivergent	Normodivergent	.03535	.26095	.991	-.6091	.6798
		Hypodivergent	-.61272	.34416	.208	-1.4626	.2372
TIncl1M	Normodivergent	Hypodivergent	-.9440	1.0423	.664	-3.518	1.630
		Hyperdivergent	.7197	.8259	.685	-1.320	2.759
	Hypodivergent	Normodivergent	.9440	1.0423	.664	-1.630	3.518
		Hyperdivergent	1.6637	1.0893	.314	-1.026	4.354
	Hyperdivergent	Normodivergent	-.7197	.8259	.685	-2.759	1.320
		Hypodivergent	-1.6637	1.0893	.314	-4.354	1.026
BIncl1M	Normodivergent	Hypodivergent	-.2061	1.0073	.979	-2.694	2.281
		Hyperdivergent	.4308	.7982	.865	-1.540	2.402
	Hypodivergent	Normodivergent	.2061	1.0073	.979	-2.281	2.694
		Hyperdivergent	.6369	1.0527	.833	-1.963	3.237
	Hyperdivergent	Normodivergent	-.4308	.7982	.865	-2.402	1.540
		Hypodivergent	-.6369	1.0527	.833	-3.237	1.963
CBB132P	Normodivergent	Hypodivergent	-.45502*	.07787	.000	-.6473	-.2627
		Hyperdivergent	.21142*	.06171	.003	.0590	.3638
	Hypodivergent	Normodivergent	.45502*	.07787	.000	.2627	.6473
		Hyperdivergent	.66643*	.08139	.000	.4655	.8674
	Hyperdivergent	Normodivergent	-.21142*	.06171	.003	-.3638	-.0590
		Hypodivergent	-.66643*	.08139	.000	-.8674	-.4655
CBB232P	Normodivergent	Hypodivergent	-.29463*	.07051	.000	-.4688	-.1205
		Hyperdivergent	.14138*	.05587	.043	.0034	.2794
	Hypodivergent	Normodivergent	.29463*	.07051	.000	.1205	.4688
		Hyperdivergent	.43601*	.07369	.000	.2540	.6180
	Hyperdivergent	Normodivergent	-.14138*	.05587	.043	-.2794	-.0034
		Hypodivergent	-.43601*	.07369	.000	-.6180	-.2540
CLB132P	Normodivergent	Hypodivergent	-.39776*	.09366	.000	-.6290	-.1665
		Hyperdivergent	.10639	.07421	.360	-.0769	.2897
	Hypodivergent	Normodivergent	.39776*	.09366	.000	.1665	.6290
		Hyperdivergent	.50415*	.09788	.000	.2624	.7459
	Hyperdivergent	Normodivergent	-.10639	.07421	.360	-.2897	.0769
		Hypodivergent	-.50415*	.09788	.000	-.7459	-.2624
CLB232P	Normodivergent	Hypodivergent	-.26405*	.07945	.005	-.4603	-.0678

	nt	Hyperdivergent	.13212	.06296	.114	-.0234	.2876
	Hypodivergent	Normodivergent	.26405*	.07945	.005	.0678	.4603
		Hyperdivergent	.39616*	.08304	.000	.1911	.6012
	Hyperdivergent	Normodivergent	-.13212	.06296	.114	-.2876	.0234
		Hypodivergent	-.39616*	.08304	.000	-.6012	-.1911
BB2P	Normodivergent	Hypodivergent	-.17215	.14545	.498	-.5313	.1870
		Hyperdivergent	.16421	.11526	.365	-.1204	.4488
	Hypodivergent	Normodivergent	.17215	.14545	.498	-.1870	.5313
		Hyperdivergent	.33636	.15201	.089	-.0390	.7117
	Hyperdivergent	Normodivergent	-.16421	.11526	.365	-.4488	.1204
		Hypodivergent	-.33636	.15201	.089	-.7117	.0390
BHT2P	Normodivergent	Hypodivergent	.06029	.59002	.995	-1.3967	1.5173
		Hyperdivergent	-.83556	.46754	.206	-1.9901	.3190
	Hypodivergent	Normodivergent	-.06029	.59002	.995	-1.5173	1.3967
		Hyperdivergent	-.89585	.61662	.350	-2.4186	.6269
	Hyperdivergent	Normodivergent	.83556	.46754	.206	-.3190	1.9901
		Hypodivergent	.89585	.61662	.350	-.6269	2.4186
BW132P	Normodivergent	Hypodivergent	-.69206	.33046	.115	-1.5081	.1240
		Hyperdivergent	.74446*	.26186	.019	.0978	1.3911
	Hypodivergent	Normodivergent	.69206	.33046	.115	-.1240	1.5081
		Hyperdivergent	1.43652*	.34536	.000	.5837	2.2894
	Hyperdivergent	Normodivergent	-.74446*	.26186	.019	-1.3911	-.0978
		Hypodivergent	-1.43652*	.34536	.000	-2.2894	-.5837
BW232P	Normodivergent	Hypodivergent	-.55004	.33082	.254	-1.3670	.2669
		Hyperdivergent	.16395	.26215	.823	-.4834	.8113
	Hypodivergent	Normodivergent	.55004	.33082	.254	-.2669	1.3670
		Hyperdivergent	.71399	.34574	.122	-.1398	1.5678
	Hyperdivergent	Normodivergent	-.16395	.26215	.823	-.8113	.4834
		Hypodivergent	-.71399	.34574	.122	-1.5678	.1398
TIncl2P	Normodivergent	Hypodivergent	-.7982	1.2806	.824	-3.961	2.364
		Hyperdivergent	3.1115*	1.0148	.010	.606	5.617
	Hypodivergent	Normodivergent	.7982	1.2806	.824	-2.364	3.961
		Hyperdivergent	3.9097*	1.3383	.016	.605	7.215
	Hyperdivergent	Normodivergent	-3.1115*	1.0148	.010	-5.617	-.606
		Hypodivergent	-3.9097*	1.3383	.016	-7.215	-.605

BIncl2P	Normodivergent	Hypodivergent	.4669	.9093	.877	-1.779	2.713
		Hyperdivergent	.0320	.7206	.999	-1.747	1.812
	Hypodivergent	Normodivergent	-.4669	.9093	.877	-2.713	1.779
		Hyperdivergent	-.4349	.9503	.901	-2.782	1.912
	Hyperdivergent	Normodivergent	-.0320	.7206	.999	-1.812	1.747
		Hypodivergent	.4349	.9503	.901	-1.912	2.782
CBB13CI	Normodivergent	Hypodivergent	-.37234*	.06248	.000	-.5266	-.2180
		Hyperdivergent	.12112	.04951	.053	-.0011	.2434
	Hypodivergent	Normodivergent	.37234*	.06248	.000	.2180	.5266
		Hyperdivergent	.49346*	.06530	.000	.3322	.6547
	Hyperdivergent	Normodivergent	-.12112	.04951	.053	-.2434	.0011
		Hypodivergent	-.49346*	.06530	.000	-.6547	-.3322
CBB23CI	Normodivergent	Hypodivergent	-.18108	.07708	.066	-.3714	.0093
		Hyperdivergent	.11904	.06108	.153	-.0318	.2699
	Hypodivergent	Normodivergent	.18108	.07708	.066	-.0093	.3714
		Hyperdivergent	.30013*	.08055	.001	.1012	.4991
	Hyperdivergent	Normodivergent	-.11904	.06108	.153	-.2699	.0318
		Hypodivergent	-.30013*	.08055	.001	-.4991	-.1012
CLB13CI	Normodivergent	Hypodivergent	-.21985*	.08227	.030	-.4230	-.0167
		Hyperdivergent	.16603*	.06519	.041	.0050	.3270
	Hypodivergent	Normodivergent	.21985*	.08227	.030	.0167	.4230
		Hyperdivergent	.38589*	.08598	.000	.1736	.5982
	Hyperdivergent	Normodivergent	-.16603*	.06519	.041	-.3270	-.0050
		Hypodivergent	-.38589*	.08598	.000	-.5982	-.1736
CLB23CI	Normodivergent	Hypodivergent	-.59208*	.15864	.001	-.9838	-.2003
		Hyperdivergent	.20872	.12571	.255	-.1017	.5192
	Hypodivergent	Normodivergent	.59208*	.15864	.001	.2003	.9838
		Hyperdivergent	.80080*	.16580	.000	.3914	1.2102
	Hyperdivergent	Normodivergent	-.20872	.12571	.255	-.5192	.1017
		Hypodivergent	-.80080*	.16580	.000	-1.2102	-.3914
BBCI	Normodivergent	Hypodivergent	-.55158*	.15026	.002	-.9226	-.1805
		Hyperdivergent	-.03918	.11907	.947	-.3332	.2549
	Hypodivergent	Normodivergent	.55158*	.15026	.002	.1805	.9226
		Hyperdivergent	.51240*	.15704	.006	.1246	.9002
	Hyperdivergent	Normodivergent	.03918	.11907	.947	-.2549	.3332

		Hypodivergent	-.51240*	.15704	.006	-.9002	-.1246
BHTCI	Normodivergent	Hypodivergent	.96995	.65252	.334	-.6414	2.5813
		Hyperdivergent	-2.49288*	.51707	.000	-3.7698	-1.2160
	Hypodivergent	Normodivergent	-.96995	.65252	.334	-2.5813	.6414
		Hyperdivergent	-3.46284*	.68195	.000	-5.1469	-1.7788
	Hyperdivergent	Normodivergent	2.49288*	.51707	.000	1.2160	3.7698
		Hypodivergent	3.46284*	.68195	.000	1.7788	5.1469
BW13CI	Normodivergent	Hypodivergent	-.85626*	.28940	.014	-1.5709	-.1416
		Hyperdivergent	1.19002*	.22933	.000	.6237	1.7563
	Hypodivergent	Normodivergent	.85626*	.28940	.014	.1416	1.5709
		Hyperdivergent	2.04628*	.30245	.000	1.2994	2.7932
	Hyperdivergent	Normodivergent	-1.19002*	.22933	.000	-1.7563	-.6237
		Hypodivergent	-2.04628*	.30245	.000	-2.7932	-1.2994
BW23CI	Normodivergent	Hypodivergent	-1.27356*	.40356	.008	-2.2701	-.2770
		Hyperdivergent	1.16711*	.31979	.002	.3774	1.9568
	Hypodivergent	Normodivergent	1.27356*	.40356	.008	.2770	2.2701
		Hyperdivergent	2.44067*	.42176	.000	1.3991	3.4822
	Hyperdivergent	Normodivergent	-1.16711*	.31979	.002	-1.9568	-.3774
		Hypodivergent	-2.44067*	.42176	.000	-3.4822	-1.3991
TInclCI	Normodivergent	Hypodivergent	-2.4428	1.5548	.294	-6.282	1.397
		Hyperdivergent	4.8734*	1.2321	.001	1.831	7.916
	Hypodivergent	Normodivergent	2.4428	1.5548	.294	-1.397	6.282
		Hyperdivergent	7.3162*	1.6249	.000	3.303	11.329
	Hyperdivergent	Normodivergent	-4.8734*	1.2321	.001	-7.916	-1.831
		Hypodivergent	-7.3162*	1.6249	.000	-11.329	-3.303
BInclCI	Normodivergent	Hypodivergent	-.5419	1.2494	.910	-3.627	2.543
		Hyperdivergent	1.9587	.9900	.144	-.486	4.403
	Hypodivergent	Normodivergent	.5419	1.2494	.910	-2.543	3.627
		Hyperdivergent	2.5005	1.3057	.163	-.724	5.725
	Hyperdivergent	Normodivergent	-1.9587	.9900	.144	-4.403	.486
		Hypodivergent	-2.5005	1.3057	.163	-5.725	.724

*. The mean difference is significant at the 0.05 level.

Age 12 to 13 Years (ANOVA)

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
CBB132M	Between Groups	3.238	2	1.619	6.450	.003
	Within Groups	15.561	62	.251		
	Total	18.799	64			
CBB232M	Between Groups	1.111	2	.556	2.543	.087
	Within Groups	13.545	62	.218		
	Total	14.656	64			
CLB132M	Between Groups	1.794	2	.897	6.312	.003
	Within Groups	8.810	62	.142		
	Total	10.603	64			
CLB232M	Between Groups	.285	2	.142	1.278	.286
	Within Groups	6.903	62	.111		
	Total	7.188	64			
BB2M	Between Groups	.129	2	.065	.269	.765
	Within Groups	14.917	62	.241		
	Total	15.047	64			
BHT2M	Between Groups	18.489	2	9.245	3.082	.053
	Within Groups	185.954	62	2.999		
	Total	204.444	64			
BW132M	Between Groups	7.143	2	3.571	1.905	.157
	Within Groups	116.206	62	1.874		
	Total	123.348	64			
BW232M	Between Groups	3.206	2	1.603	1.067	.350
	Within Groups	93.104	62	1.502		
	Total	96.310	64			
TIncl2M	Between Groups	99.555	2	49.777	.930	.400
	Within Groups	3317.900	62	53.515		
	Total	3417.454	64			
BIncl2M	Between Groups	1.199	2	.599	.031	.970
	Within Groups	1216.422	62	19.620		
	Total	1217.621	64			
CBB131M	Between Groups	3.801	2	1.901	9.690	.000
	Within Groups	12.160	62	.196		
	Total	15.961	64			
CBB231M	Between Groups	1.979	2	.990	7.109	.002
	Within Groups	8.632	62	.139		
	Total	10.611	64			
CLB131M	Between Groups	2.619	2	1.310	5.218	.008
	Within Groups	15.560	62	.251		
	Total	18.179	64			
CLB231M	Between Groups	1.010	2	.505	3.891	.026
	Within Groups	8.043	62	.130		
	Total	9.052	64			

BB1M	Between Groups	.159	2	.079	.255	.776
	Within Groups	19.357	62	.312		
	Total	19.516	64			
BHT1M	Between Groups	9.361	2	4.681	1.088	.343
	Within Groups	266.853	62	4.304		
	Total	276.215	64			
BW131M	Between Groups	17.376	2	8.688	5.224	.008
	Within Groups	103.124	62	1.663		
	Total	120.500	64			
BW231M	Between Groups	9.916	2	4.958	2.509	.090
	Within Groups	122.514	62	1.976		
	Total	132.430	64			
TIncl1M	Between Groups	1.916	2	.958	.056	.945
	Within Groups	1055.605	62	17.026		
	Total	1057.521	64			
BIncl1M	Between Groups	64.638	2	32.319	2.183	.121
	Within Groups	917.892	62	14.805		
	Total	982.530	64			
CBB132P	Between Groups	3.757	2	1.878	13.271	.000
	Within Groups	8.775	62	.142		
	Total	12.532	64			
CBB232P	Between Groups	2.106	2	1.053	8.683	.000
	Within Groups	7.517	62	.121		
	Total	9.623	64			
CLB132P	Between Groups	3.082	2	1.541	8.164	.001
	Within Groups	11.702	62	.189		
	Total	14.783	64			
CLB232P	Between Groups	.420	2	.210	1.843	.167
	Within Groups	7.064	62	.114		
	Total	7.484	64			
BB2P	Between Groups	1.083	2	.542	1.233	.299
	Within Groups	27.247	62	.439		
	Total	28.330	64			
BHT2P	Between Groups	14.976	2	7.488	1.361	.264
	Within Groups	341.234	62	5.504		
	Total	356.210	64			
BW132P	Between Groups	24.788	2	12.394	6.014	.004
	Within Groups	127.782	62	2.061		
	Total	152.570	64			
BW232P	Between Groups	6.397	2	3.198	1.510	.229
	Within Groups	131.352	62	2.119		
	Total	137.749	64			
TIncl2P	Between Groups	25.377	2	12.688	.351	.706
	Within Groups	2244.185	62	36.197		
	Total	2269.562	64			
BIncl2P	Between Groups	122.693	2	61.347	4.620	.013
	Within Groups	823.352	62	13.280		

		Sum of Squares	df	Mean Square	F	Sig.
	Total	946.046	64			
CBB13CI	Between Groups	1.411	2	.705	7.560	.001
	Within Groups	5.785	62	.093		
	Total	7.196	64			
CBB23CI	Between Groups	.927	2	.463	4.134	.021
	Within Groups	6.948	62	.112		
	Total	7.875	64			
CLB13CI	Between Groups	1.641	2	.821	6.367	.003
	Within Groups	7.991	62	.129		
	Total	9.633	64			
CLB23CI	Between Groups	1.050	2	.525	1.068	.350
	Within Groups	30.478	62	.492		
	Total	31.528	64			
BBCI	Between Groups	4.086	2	2.043	4.092	.021
	Within Groups	30.951	62	.499		
	Total	35.037	64			
BHTCI	Between Groups	145.547	2	72.773	8.641	.000
	Within Groups	522.168	62	8.422		
	Total	667.715	64			
BW13CI	Between Groups	26.743	2	13.372	9.012	.000
	Within Groups	91.991	62	1.484		
	Total	118.734	64			
BW23CI	Between Groups	16.157	2	8.079	2.169	.123
	Within Groups	230.963	62	3.725		
	Total	247.120	64			
TInclCI	Between Groups	75.454	2	37.727	.726	.488
	Within Groups	3222.867	62	51.982		
	Total	3298.321	64			
BInclCI	Between Groups	54.517	2	27.259	.857	.429
	Within Groups	1971.965	62	31.806		
	Total	2026.482	64			

Age 12 to 13 Years (Scheffé)

Multiple Comparisons

Scheffe

Dependent Variable	(I) FaceTyp	(J) FaceTyp	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
CBB132M	Normodivergent	Hypodivergent	-.39117	.17317	.086	-.8255	.0432
		Hyperdivergent	.28797	.14276	.139	-.0701	.6460
	Hypodivergent	Normodivergent	.39117	.17317	.086	-.0432	.8255
		Hyperdivergent	.67914*	.18980	.003	.2031	1.1552
	Hyperdivergent	Normodivergent	-.28797	.14276	.139	-.6460	.0701
		Hypodivergent	-.67914*	.18980	.003	-1.1552	-.2031
CBB232M	Normodivergent	Hypodivergent	-.34223	.16156	.115	-.7474	.0630
		Hyperdivergent	.01686	.13319	.992	-.3172	.3509
	Hypodivergent	Normodivergent	.34223	.16156	.115	-.0630	.7474
		Hyperdivergent	.35909	.17708	.137	-.0851	.8032
	Hyperdivergent	Normodivergent	-.01686	.13319	.992	-.3509	.3172

		Hypodivergent	-.35909	.17708	.137	-.8032	.0851
CLB132M	Normodivergent	Hypodivergent	-.27740	.13030	.112	-.6042	.0494
		Hyperdivergent	.22609	.10742	.118	-.0433	.4955
	Hypodivergent	Normodivergent	.27740	.13030	.112	-.0494	.6042
		Hyperdivergent	.50349*	.14281	.003	.1453	.8617
	Hyperdivergent	Normodivergent	-.22609	.10742	.118	-.4955	.0433
		Hypodivergent	-.50349*	.14281	.003	-.8617	-.1453
CLB232M	Normodivergent	Hypodivergent	-.09873	.11534	.695	-.3880	.1906
		Hyperdivergent	.09926	.09509	.583	-.1392	.3377
	Hypodivergent	Normodivergent	.09873	.11534	.695	-.1906	.3880
		Hyperdivergent	.19799	.12642	.300	-.1191	.5151
	Hyperdivergent	Normodivergent	-.09926	.09509	.583	-.3377	.1392
		Hypodivergent	-.19799	.12642	.300	-.5151	.1191
BB2M	Normodivergent	Hypodivergent	.07332	.16955	.911	-.3519	.4986
		Hyperdivergent	.09672	.13978	.788	-.2539	.4473
	Hypodivergent	Normodivergent	-.07332	.16955	.911	-.4986	.3519
		Hyperdivergent	.02340	.18584	.992	-.4427	.4895
	Hyperdivergent	Normodivergent	-.09672	.13978	.788	-.4473	.2539
		Hypodivergent	-.02340	.18584	.992	-.4895	.4427
BHT2M	Normodivergent	Hypodivergent	.54166	.59863	.666	-.9597	2.0431
		Hyperdivergent	1.22152	.49351	.054	-.0162	2.4593
	Hypodivergent	Normodivergent	-.54166	.59863	.666	-2.0431	.9597
		Hyperdivergent	.67986	.65614	.587	-.9658	2.3255
	Hyperdivergent	Normodivergent	-1.22152	.49351	.054	-2.4593	.0162
		Hypodivergent	-.67986	.65614	.587	-2.3255	.9658
BW132M	Normodivergent	Hypodivergent	-.92356	.47322	.158	-2.1104	.2633
		Hyperdivergent	-.20418	.39012	.872	-1.1826	.7743
	Hypodivergent	Normodivergent	.92356	.47322	.158	-.2633	2.1104
		Hyperdivergent	.71938	.51869	.388	-.5815	2.0203
	Hyperdivergent	Normodivergent	.20418	.39012	.872	-.7743	1.1826
		Hypodivergent	-.71938	.51869	.388	-2.0203	.5815
BW232M	Normodivergent	Hypodivergent	-.59665	.42358	.377	-1.6590	.4657
		Hyperdivergent	-.27239	.34920	.739	-1.1482	.6034
	Hypodivergent	Normodivergent	.59665	.42358	.377	-.4657	1.6590
		Hyperdivergent	.32426	.46428	.784	-.8402	1.4887
	Hyperdivergent	Normodivergent	.27239	.34920	.739	-.6034	1.1482
		Hypodivergent	-.32426	.46428	.784	-1.4887	.8402
TIncl2M	Normodivergent	Hypodivergent	3.2906	2.5286	.434	-3.051	9.633
		Hyperdivergent	1.6017	2.0846	.745	-3.627	6.830
	Hypodivergent	Normodivergent	-3.2906	2.5286	.434	-9.633	3.051
		Hyperdivergent	-1.6890	2.7716	.831	-8.640	5.262
	Hyperdivergent	Normodivergent	-1.6017	2.0846	.745	-6.830	3.627
		Hypodivergent	1.6890	2.7716	.831	-5.262	8.640
BIncl2M	Normodivergent	Hypodivergent	.2060	1.5311	.991	-3.634	4.046
		Hyperdivergent	-.2012	1.2622	.987	-3.367	2.965
	Hypodivergent	Normodivergent	-.2060	1.5311	.991	-4.046	3.634
		Hyperdivergent	-.4072	1.6782	.971	-4.616	3.802
	Hyperdivergent	Normodivergent	.2012	1.2622	.987	-2.965	3.367
		Hypodivergent	.4072	1.6782	.971	-3.802	4.616
CBB131M	Normodivergent	Hypodivergent	-.54288*	.15308	.003	-.9268	-.1589
		Hyperdivergent	.18520	.12620	.347	-.1313	.5017
	Hypodivergent	Normodivergent	.54288*	.15308	.003	.1589	.9268
		Hyperdivergent	.72809*	.16779	.000	.3073	1.1489
	Hyperdivergent	Normodivergent	-.18520	.12620	.347	-.5017	.1313
		Hypodivergent	-.72809*	.16779	.000	-1.1489	-.3073
CBB231M	Normodivergent	Hypodivergent	-.38099*	.12897	.017	-.7045	-.0575
		Hyperdivergent	.14734	.10633	.388	-.1193	.4140
	Hypodivergent	Normodivergent	.38099*	.12897	.017	.0575	.7045
		Hyperdivergent	.52833*	.14136	.002	.1738	.8829
	Hyperdivergent	Normodivergent	-.14734	.10633	.388	-.4140	.1193
		Hypodivergent	-.52833*	.14136	.002	-.8829	-.1738
CLB131M	Normodivergent	Hypodivergent	-.40691	.17316	.071	-.8412	.0274
		Hyperdivergent	.20558	.14276	.361	-.1525	.5636

	Hypodivergent	Normodivergent	.40691	.17316	.071	-.0274	.8412
		Hyperdivergent	.61249*	.18980	.008	.1365	1.0885
	Hyperdivergent	Normodivergent	-.20558	.14276	.361	-.5636	.1525
		Hypodivergent	-.61249*	.18980	.008	-1.0885	-.1365
CLB231M	Normodivergent	Hypodivergent	-.18782	.12450	.327	-.5001	.1244
		Hyperdivergent	.18558	.10263	.203	-.0718	.4430
	Hypodivergent	Normodivergent	.18782	.12450	.327	-.1244	.5001
		Hyperdivergent	.37340*	.13646	.029	.0311	.7156
	Hyperdivergent	Normodivergent	-.18558	.10263	.203	-.4430	.0718
		Hypodivergent	-.37340*	.13646	.029	-.7156	-.0311
BB1M	Normodivergent	Hypodivergent	.02101	.19314	.994	-.4634	.5054
		Hyperdivergent	.11250	.15922	.780	-.2869	.5118
	Hypodivergent	Normodivergent	-.02101	.19314	.994	-.5054	.4634
		Hyperdivergent	.09148	.21170	.911	-.4395	.6224
	Hyperdivergent	Normodivergent	-.11250	.15922	.780	-.5118	.2869
		Hypodivergent	-.09148	.21170	.911	-.6224	.4395
BHT1M	Normodivergent	Hypodivergent	1.04426	.71712	.353	-.7543	2.8428
		Hyperdivergent	.38182	.59119	.812	-1.1009	1.8646
	Hypodivergent	Normodivergent	-1.04426	.71712	.353	-2.8428	.7543
		Hyperdivergent	-.66244	.78601	.702	-2.6338	1.3089
	Hyperdivergent	Normodivergent	-.38182	.59119	.812	-1.8646	1.1009
		Hypodivergent	.66244	.78601	.702	-1.3089	2.6338
BW131M	Normodivergent	Hypodivergent	-1.33621*	.44579	.015	-2.4543	-.2181
		Hyperdivergent	.10585	.36751	.959	-.8159	1.0276
	Hypodivergent	Normodivergent	1.33621*	.44579	.015	.2181	2.4543
		Hyperdivergent	1.44206*	.48862	.017	.2166	2.6676
	Hyperdivergent	Normodivergent	-.10585	.36751	.959	-1.0276	.8159
		Hypodivergent	-1.44206*	.48862	.017	-2.6676	-.2166
BW231M	Normodivergent	Hypodivergent	-1.06644	.48590	.098	-2.2851	.1522
		Hyperdivergent	-.08319	.40057	.979	-1.0879	.9215
	Hypodivergent	Normodivergent	1.06644	.48590	.098	-.1522	2.2851
		Hyperdivergent	.98325	.53258	.190	-.3525	2.3190
	Hyperdivergent	Normodivergent	.08319	.40057	.979	-.9215	1.0879
		Hypodivergent	-.98325	.53258	.190	-2.3190	.3525
TIncl1M	Normodivergent	Hypodivergent	-.3525	1.4263	.970	-3.930	3.225
		Hyperdivergent	-.3395	1.1758	.959	-3.289	2.610
	Hypodivergent	Normodivergent	.3525	1.4263	.970	-3.225	3.930
		Hyperdivergent	.0129	1.5633	1.000	-3.908	3.934
	Hyperdivergent	Normodivergent	.3395	1.1758	.959	-2.610	3.289
		Hypodivergent	-.0129	1.5633	1.000	-3.934	3.908
BIncl1M	Normodivergent	Hypodivergent	1.9434	1.3300	.350	-1.392	5.279
		Hyperdivergent	-1.1026	1.0964	.606	-3.853	1.647
	Hypodivergent	Normodivergent	-1.9434	1.3300	.350	-5.279	1.392
		Hyperdivergent	-3.0459	1.4578	.121	-6.702	.610
	Hyperdivergent	Normodivergent	1.1026	1.0964	.606	-1.647	3.853
		Hypodivergent	3.0459	1.4578	.121	-.610	6.702
CBB132P	Normodivergent	Hypodivergent	-.53678*	.13004	.001	-.8629	-.2106
		Hyperdivergent	.18791	.10721	.223	-.0810	.4568
	Hypodivergent	Normodivergent	.53678*	.13004	.001	.2106	.8629
		Hyperdivergent	.72469*	.14253	.000	.3672	1.0822
	Hyperdivergent	Normodivergent	-.18791	.10721	.223	-.4568	.0810
		Hypodivergent	-.72469*	.14253	.000	-1.0822	-.3672
CBB232P	Normodivergent	Hypodivergent	-.39268*	.12036	.007	-.6945	-.0908
		Hyperdivergent	.15230	.09922	.315	-.0966	.4012
	Hypodivergent	Normodivergent	.39268*	.12036	.007	.0908	.6945
		Hyperdivergent	.54498*	.13192	.001	.2141	.8759
	Hyperdivergent	Normodivergent	-.15230	.09922	.315	-.4012	.0966
		Hypodivergent	-.54498*	.13192	.001	-.8759	-.2141
CLB132P	Normodivergent	Hypodivergent	-.52553*	.15017	.004	-.9022	-.1489
		Hyperdivergent	.11365	.12380	.658	-.1968	.4241
	Hypodivergent	Normodivergent	.52553*	.15017	.004	.1489	.9022
		Hyperdivergent	.63919*	.16459	.001	.2264	1.0520
	Hyperdivergent	Normodivergent	-.11365	.12380	.658	-.4241	.1968

		Hypodivergent	-.63919*	.16459	.001	-1.0520	-.2264
CLB232P	Normodivergent	Hypodivergent	-.21956	.11667	.179	-.5122	.0731
		Hyperdivergent	-.01755	.09618	.983	-.2588	.2237
	Hypodivergent	Normodivergent	.21956	.11667	.179	-.0731	.5122
		Hyperdivergent	.20201	.12788	.294	-.1187	.5227
	Hyperdivergent	Normodivergent	.01755	.09618	.983	-.2237	.2588
		Hypodivergent	-.20201	.12788	.294	-.5227	.1187
BB2P	Normodivergent	Hypodivergent	.11951	.22915	.873	-.4552	.6942
		Hyperdivergent	.29630	.18891	.299	-.1775	.7701
	Hypodivergent	Normodivergent	-.11951	.22915	.873	-.6942	.4552
		Hyperdivergent	.17679	.25116	.781	-.4531	.8067
	Hyperdivergent	Normodivergent	-.29630	.18891	.299	-.7701	.1775
		Hypodivergent	-.17679	.25116	.781	-.8067	.4531
BHT2P	Normodivergent	Hypodivergent	1.24195	.81092	.316	-.7919	3.2758
		Hyperdivergent	-.09504	.66852	.990	-1.7718	1.5817
	Hypodivergent	Normodivergent	-1.24195	.81092	.316	-3.2758	.7919
		Hyperdivergent	-1.33699	.88883	.329	-3.5662	.8923
	Hyperdivergent	Normodivergent	.09504	.66852	.990	-1.5817	1.7718
		Hypodivergent	1.33699	.88883	.329	-.8923	3.5662
BW132P	Normodivergent	Hypodivergent	-1.58639*	.49623	.009	-2.8310	-.3418
		Hyperdivergent	.14701	.40910	.938	-.8790	1.1731
	Hypodivergent	Normodivergent	1.58639*	.49623	.009	.3418	2.8310
		Hyperdivergent	1.73340*	.54391	.009	.3692	3.0976
	Hyperdivergent	Normodivergent	-.14701	.40910	.938	-1.1731	.8790
		Hypodivergent	-1.73340*	.54391	.009	-3.0976	-.3692
BW232P	Normodivergent	Hypodivergent	-.83610	.50312	.259	-2.0980	.4258
		Hyperdivergent	.00150	.41477	1.000	-1.0388	1.0418
	Hypodivergent	Normodivergent	.83610	.50312	.259	-.4258	2.0980
		Hyperdivergent	.83761	.55146	.322	-.5455	2.2207
	Hyperdivergent	Normodivergent	-.00150	.41477	1.000	-1.0418	1.0388
		Hypodivergent	-.83761	.55146	.322	-2.2207	.5455
TIncl2P	Normodivergent	Hypodivergent	-.5784	2.0796	.962	-5.794	4.637
		Hyperdivergent	1.1574	1.7144	.797	-3.142	5.457
	Hypodivergent	Normodivergent	.5784	2.0796	.962	-4.637	5.794
		Hyperdivergent	1.7359	2.2794	.749	-3.981	7.453
	Hyperdivergent	Normodivergent	-1.1574	1.7144	.797	-5.457	3.142
		Hypodivergent	-1.7359	2.2794	.749	-7.453	3.981
BIncl2P	Normodivergent	Hypodivergent	3.3106*	1.2596	.038	.151	6.470
		Hyperdivergent	-.7257	1.0384	.784	-3.330	1.879
	Hypodivergent	Normodivergent	-3.3106*	1.2596	.038	-6.470	-.151
		Hyperdivergent	-4.0364*	1.3807	.018	-7.499	-.574
	Hyperdivergent	Normodivergent	.7257	1.0384	.784	-1.879	3.330
		Hypodivergent	4.0364*	1.3807	.018	.574	7.499
CBB13CI	Normodivergent	Hypodivergent	-.31361*	.10558	.016	-.5784	-.0488
		Hyperdivergent	.13405	.08704	.312	-.0843	.3524
	Hypodivergent	Normodivergent	.31361*	.10558	.016	.0488	.5784
		Hyperdivergent	.44766*	.11573	.001	.1574	.7379
	Hyperdivergent	Normodivergent	-.13405	.08704	.312	-.3524	.0843
		Hypodivergent	-.44766*	.11573	.001	-.7379	-.1574
CBB23CI	Normodivergent	Hypodivergent	-.25382	.11572	.099	-.5440	.0364
		Hyperdivergent	.10905	.09540	.524	-.1302	.3483
	Hypodivergent	Normodivergent	.25382	.11572	.099	-.0364	.5440
		Hyperdivergent	.36287*	.12683	.021	.0448	.6810
	Hyperdivergent	Normodivergent	-.10905	.09540	.524	-.3483	.1302
		Hypodivergent	-.36287*	.12683	.021	-.6810	-.0448
CLB13CI	Normodivergent	Hypodivergent	-.38114*	.12410	.012	-.6924	-.0699
		Hyperdivergent	.08675	.10231	.699	-.1698	.3433
	Hypodivergent	Normodivergent	.38114*	.12410	.012	.0699	.6924
		Hyperdivergent	.46789*	.13602	.004	.1267	.8090
	Hyperdivergent	Normodivergent	-.08675	.10231	.699	-.3433	.1698
		Hypodivergent	-.46789*	.13602	.004	-.8090	-.1267
CLB23CI	Normodivergent	Hypodivergent	-.34153	.24235	.376	-.9494	.2663
		Hyperdivergent	-.00761	.19979	.999	-.5087	.4935

	Hypodivergent	Normodivergent	.34153	.24235	.376	-.2663	.9494
		Hyperdivergent	.33392	.26563	.458	-.3323	1.0002
	Hyperdivergent	Normodivergent	.00761	.19979	.999	-.4935	.5087
		Hypodivergent	-.33392	.26563	.458	-1.0002	.3323
BBCI	Normodivergent	Hypodivergent	-.63221*	.24423	.042	-1.2447	-.0197
		Hyperdivergent	.08353	.20134	.918	-.4214	.5885
	Hypodivergent	Normodivergent	.63221*	.24423	.042	.0197	1.2447
		Hyperdivergent	.71574*	.26769	.034	.0444	1.3871
	Hyperdivergent	Normodivergent	-.08353	.20134	.918	-.5885	.4214
		Hypodivergent	-.71574*	.26769	.034	-1.3871	-.0444
BHTCI	Normodivergent	Hypodivergent	1.64070	1.00313	.270	-.8752	4.1566
		Hyperdivergent	-2.63236*	.82698	.009	-4.7065	-.5582
	Hypodivergent	Normodivergent	-1.64070	1.00313	.270	-4.1566	.8752
		Hyperdivergent	-4.27306*	1.09950	.001	-7.0307	-1.5154
	Hyperdivergent	Normodivergent	2.63236*	.82698	.009	.5582	4.7065
		Hypodivergent	4.27306*	1.09950	.001	1.5154	7.0307
BW13CI	Normodivergent	Hypodivergent	-1.00904	.42104	.064	-2.0651	.0470
		Hyperdivergent	.92283*	.34711	.035	.0523	1.7934
	Hypodivergent	Normodivergent	1.00904	.42104	.064	-.0470	2.0651
		Hyperdivergent	1.93187*	.46149	.000	.7744	3.0893
	Hyperdivergent	Normodivergent	-.92283*	.34711	.035	-1.7934	-.0523
		Hypodivergent	-1.93187*	.46149	.000	-3.0893	-.7744
BW23CI	Normodivergent	Hypodivergent	-.38244	.66715	.849	-2.0557	1.2908
		Hyperdivergent	.96239	.55000	.224	-.4171	2.3418
	Hypodivergent	Normodivergent	.38244	.66715	.849	-1.2908	2.0557
		Hyperdivergent	1.34483	.73124	.193	-.4892	3.1789
	Hyperdivergent	Normodivergent	-.96239	.55000	.224	-2.3418	.4171
		Hypodivergent	-1.34483	.73124	.193	-3.1789	.4892
TInclCI	Normodivergent	Hypodivergent	-1.9465	2.4921	.738	-8.197	4.304
		Hyperdivergent	1.3382	2.0545	.809	-3.815	6.491
	Hypodivergent	Normodivergent	1.9465	2.4921	.738	-4.304	8.197
		Hyperdivergent	3.2847	2.7316	.489	-3.566	10.136
	Hyperdivergent	Normodivergent	-1.3382	2.0545	.809	-6.491	3.815
		Hypodivergent	-3.2847	2.7316	.489	-10.136	3.566
BInclCI	Normodivergent	Hypodivergent	1.5748	1.9494	.723	-3.314	6.464
		Hyperdivergent	-1.2080	1.6071	.755	-5.239	2.823
	Hypodivergent	Normodivergent	-1.5748	1.9494	.723	-6.464	3.314
		Hyperdivergent	-2.7828	2.1367	.433	-8.142	2.576
	Hyperdivergent	Normodivergent	1.2080	1.6071	.755	-2.823	5.239
		Hypodivergent	2.7828	2.1367	.433	-2.576	8.142

*. The mean difference is significant at the 0.05 level.

Age 14 to 15 Years (ANOVA)

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
CBB132M	Between Groups	3.456	2	1.728	9.632	.000
	Within Groups	12.917	72	.179		
	Total	16.373	74			
CBB232M	Between Groups	1.986	2	.993	5.293	.007
	Within Groups	13.508	72	.188		
	Total	15.494	74			
CLB132M	Between Groups	3.023	2	1.511	8.365	.001
	Within Groups	13.009	72	.181		
	Total	16.031	74			
CLB232M	Between Groups	2.825	2	1.413	9.791	.000

	Within Groups	10.389	72	.144		
	Total	13.214	74			
BB2M	Between Groups	.558	2	.279	1.163	.318
	Within Groups	17.274	72	.240		
	Total	17.832	74			
BHT2M	Between Groups	15.998	2	7.999	1.790	.174
	Within Groups	321.700	72	4.468		
	Total	337.698	74			
BW132M	Between Groups	10.063	2	5.031	2.083	.132
	Within Groups	173.943	72	2.416		
	Total	184.006	74			
BW232M	Between Groups	10.220	2	5.110	2.772	.069
	Within Groups	132.731	72	1.843		
	Total	142.951	74			
TIncl2M	Between Groups	12.328	2	6.164	.155	.857
	Within Groups	2868.491	72	39.840		
	Total	2880.819	74			
BIncl2M	Between Groups	154.075	2	77.037	3.344	.041
	Within Groups	1658.773	72	23.039		
	Total	1812.847	74			
CBB131M	Between Groups	5.143	2	2.572	13.489	.000
	Within Groups	13.727	72	.191		
	Total	18.870	74			
CBB231M	Between Groups	2.348	2	1.174	7.693	.001
	Within Groups	10.988	72	.153		
	Total	13.337	74			
CLB131M	Between Groups	3.861	2	1.931	8.425	.001
	Within Groups	16.498	72	.229		
	Total	20.359	74			
CLB231M	Between Groups	1.788	2	.894	6.985	.002
	Within Groups	9.216	72	.128		
	Total	11.004	74			
BB1M	Between Groups	.611	2	.305	1.004	.371
	Within Groups	21.902	72	.304		
	Total	22.513	74			
BHT1M	Between Groups	2.386	2	1.193	.190	.827
	Within Groups	451.895	72	6.276		
	Total	454.281	74			
BW131M	Between Groups	8.249	2	4.125	1.971	.147
	Within Groups	150.698	72	2.093		
	Total	158.947	74			
BW231M	Between Groups	1.758	2	.879	.313	.732
	Within Groups	202.158	72	2.808		
	Total	203.916	74			
TIncl1M	Between Groups	19.309	2	9.654	.342	.712
	Within Groups	2033.012	72	28.236		
	Total	2052.321	74			

BIncl1M	Between Groups	79.215	2	39.607	1.738	.183
	Within Groups	1640.905	72	22.790		
	Total	1720.119	74			
CBB132P	Between Groups	3.547	2	1.773	14.226	.000
	Within Groups	8.976	72	.125		
	Total	12.522	74			
CBB232P	Between Groups	1.499	2	.750	8.814	.000
	Within Groups	6.124	72	.085		
	Total	7.624	74			
CLB132P	Between Groups	1.707	2	.854	4.241	.018
	Within Groups	14.494	72	.201		
	Total	16.202	74			
CLB232P	Between Groups	2.506	2	1.253	7.787	.001
	Within Groups	11.586	72	.161		
	Total	14.092	74			
BB2P	Between Groups	1.546	2	.773	2.218	.116
	Within Groups	25.082	72	.348		
	Total	26.628	74			
BHT2P	Between Groups	6.209	2	3.104	.500	.609
	Within Groups	447.259	72	6.212		
	Total	453.468	74			
BW132P	Between Groups	15.726	2	7.863	2.870	.063
	Within Groups	197.243	72	2.739		
	Total	212.968	74			
BW232P	Between Groups	3.710	2	1.855	.621	.540
	Within Groups	215.151	72	2.988		
	Total	218.861	74			
TIncl2P	Between Groups	275.055	2	137.528	3.713	.029
	Within Groups	2666.634	72	37.037		
	Total	2941.689	74			
BIncl2P	Between Groups	23.428	2	11.714	.629	.536
	Within Groups	1340.600	72	18.619		
	Total	1364.027	74			
CBB13CI	Between Groups	2.792	2	1.396	21.375	.000
	Within Groups	4.702	72	.065		
	Total	7.494	74			
CBB23CI	Between Groups	1.533	2	.766	5.529	.006
	Within Groups	9.980	72	.139		
	Total	11.512	74			
CLB13CI	Between Groups	2.073	2	1.036	6.924	.002
	Within Groups	10.778	72	.150		
	Total	12.850	74			
CLB23CI	Between Groups	8.411	2	4.205	6.849	.002
	Within Groups	44.212	72	.614		
	Total	52.623	74			
BBCI	Between Groups	1.031	2	.516	1.139	.326
	Within Groups	32.602	72	.453		

	Total	33.633	74			
BHTCI	Between Groups	112.425	2	56.213	6.071	.004
	Within Groups	666.691	72	9.260		
	Total	779.117	74			
BW13CI	Between Groups	40.142	2	20.071	10.823	.000
	Within Groups	133.520	72	1.854		
	Total	173.662	74			
BW23CI	Between Groups	57.579	2	28.789	8.553	.000
	Within Groups	242.344	72	3.366		
	Total	299.923	74			
TInclCI	Between Groups	845.104	2	422.552	8.032	.001
	Within Groups	3787.979	72	52.611		
	Total	4633.083	74			
BInclCI	Between Groups	248.749	2	124.374	3.657	.031
	Within Groups	2448.754	72	34.010		
	Total	2697.503	74			

Age 14 to 15 Years (Scheffé)

Multiple Comparisons

Scheffe

Dependent Variable	(I) FaceTyp	(J) FaceTyp	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
CBB132M	Normodivergent	Hypodivergent	-.33715	.14026	.062	-.6877	.0134
		Hyperdivergent	.30008*	.10908	.027	.0274	.5727
	Hypodivergent	Normodivergent	.33715	.14026	.062	-.0134	.6877
		Hyperdivergent	.63723*	.14875	.000	.2654	1.0090
	Hyperdivergent	Normodivergent	-.30008*	.10908	.027	-.5727	-.0274
		Hypodivergent	-.63723*	.14875	.000	-1.0090	-.2654
CBB232M	Normodivergent	Hypodivergent	-.42855*	.14343	.015	-.7871	-.0700
		Hyperdivergent	.03375	.11154	.955	-.2451	.3126
	Hypodivergent	Normodivergent	.42855*	.14343	.015	.0700	.7871
		Hyperdivergent	.46230*	.15212	.013	.0821	.8425
	Hyperdivergent	Normodivergent	-.03375	.11154	.955	-.3126	.2451
		Hypodivergent	-.46230*	.15212	.013	-.8425	-.0821
CLB132M	Normodivergent	Hypodivergent	-.25338	.14075	.205	-.6052	.0984
		Hyperdivergent	.32159*	.10946	.017	.0480	.5952
	Hypodivergent	Normodivergent	.25338	.14075	.205	-.0984	.6052
		Hyperdivergent	.57497*	.14928	.001	.2018	.9481
	Hyperdivergent	Normodivergent	-.32159*	.10946	.017	-.5952	-.0480
		Hypodivergent	-.57497*	.14928	.001	-.9481	-.2018
CLB232M	Normodivergent	Hypodivergent	-.42232*	.12578	.005	-.7367	-.1079
		Hyperdivergent	.16684	.09782	.240	-.0777	.4113
	Hypodivergent	Normodivergent	.42232*	.12578	.005	.1079	.7367
		Hyperdivergent	.58917*	.13340	.000	.2557	.9226
	Hyperdivergent	Normodivergent	-.16684	.09782	.240	-.4113	.0777
		Hypodivergent	-.58917*	.13340	.000	-.9226	-.2557
BB2M	Normodivergent	Hypodivergent	-.10908	.16219	.798	-.5145	.2963
		Hyperdivergent	.13802	.12614	.552	-.1773	.4533
	Hypodivergent	Normodivergent	.10908	.16219	.798	-.2963	.5145
		Hyperdivergent	.24710	.17202	.362	-.1829	.6771
	Hyperdivergent	Normodivergent	-.13802	.12614	.552	-.4533	.1773
		Hypodivergent	-.24710	.17202	.362	-.6771	.1829

BHT2M	Normodivergent	Hypodivergent	-.49206	.69994	.782	-2.2416	1.2575
		Hyperdivergent	.79151	.54434	.353	-.5691	2.1521
	Hypodivergent	Normodivergent	.49206	.69994	.782	-1.2575	2.2416
		Hyperdivergent	1.28357	.74233	.231	-.5719	3.1391
	Hyperdivergent	Normodivergent	-.79151	.54434	.353	-2.1521	.5691
		Hypodivergent	-1.28357	.74233	.231	-3.1391	.5719
BW132M	Normodivergent	Hypodivergent	-.32785	.51468	.817	-1.6143	.9586
		Hyperdivergent	.65952	.40026	.264	-.3410	1.6600
	Hypodivergent	Normodivergent	.32785	.51468	.817	-.9586	1.6143
		Hyperdivergent	.98737	.54586	.202	-.3770	2.3518
	Hyperdivergent	Normodivergent	-.65952	.40026	.264	-1.6600	.3410
		Hypodivergent	-.98737	.54586	.202	-2.3518	.3770
BW232M	Normodivergent	Hypodivergent	-1.05667	.44960	.070	-2.1805	.0671
		Hyperdivergent	-.20640	.34965	.840	-1.0804	.6676
	Hypodivergent	Normodivergent	1.05667	.44960	.070	-.0671	2.1805
		Hyperdivergent	.85027	.47683	.211	-.3416	2.0421
	Hyperdivergent	Normodivergent	.20640	.34965	.840	-.6676	1.0804
		Hypodivergent	-.85027	.47683	.211	-2.0421	.3416
TIncl2M	Normodivergent	Hypodivergent	-.8408	2.0901	.922	-6.065	4.383
		Hyperdivergent	.3922	1.6254	.971	-3.671	4.455
	Hypodivergent	Normodivergent	.8408	2.0901	.922	-4.383	6.065
		Hyperdivergent	1.2330	2.2167	.857	-4.308	6.774
	Hyperdivergent	Normodivergent	-.3922	1.6254	.971	-4.455	3.671
		Hypodivergent	-1.2330	2.2167	.857	-6.774	4.308
BIncl2M	Normodivergent	Hypodivergent	-.7746	1.5894	.888	-4.747	3.198
		Hyperdivergent	2.8001	1.2360	.084	-.289	5.890
	Hypodivergent	Normodivergent	.7746	1.5894	.888	-3.198	4.747
		Hyperdivergent	3.5747	1.6857	.113	-.639	7.788
	Hyperdivergent	Normodivergent	-2.8001	1.2360	.084	-5.890	.289
		Hypodivergent	-3.5747	1.6857	.113	-7.788	.639
CBB131M	Normodivergent	Hypodivergent	-.39513*	.14458	.029	-.7565	-.0337
		Hyperdivergent	.37757*	.11244	.005	.0965	.6586
	Hypodivergent	Normodivergent	.39513*	.14458	.029	.0337	.7565
		Hyperdivergent	.77270*	.15334	.000	.3894	1.1560
	Hyperdivergent	Normodivergent	-.37757*	.11244	.005	-.6586	-.0965
		Hypodivergent	-.77270*	.15334	.000	-1.1560	-.3894
CBB231M	Normodivergent	Hypodivergent	-.38206*	.12936	.016	-.7054	-.0587
		Hyperdivergent	.15531	.10060	.310	-.0962	.4068
	Hypodivergent	Normodivergent	.38206*	.12936	.016	.0587	.7054
		Hyperdivergent	.53737*	.13720	.001	.1944	.8803
	Hyperdivergent	Normodivergent	-.15531	.10060	.310	-.4068	.0962
		Hypodivergent	-.53737*	.13720	.001	-.8803	-.1944
CLB131M	Normodivergent	Hypodivergent	-.44579*	.15851	.023	-.8420	-.0496
		Hyperdivergent	.24361	.12327	.149	-.0645	.5517
	Hypodivergent	Normodivergent	.44579*	.15851	.023	.0496	.8420
		Hyperdivergent	.68940*	.16811	.001	.2692	1.1096
	Hyperdivergent	Normodivergent	-.24361	.12327	.149	-.5517	.0645
		Hypodivergent	-.68940*	.16811	.001	-1.1096	-.2692
CLB231M	Normodivergent	Hypodivergent	-.23544	.11847	.146	-.5316	.0607
		Hyperdivergent	.22089	.09213	.063	-.0094	.4512
	Hypodivergent	Normodivergent	.23544	.11847	.146	-.0607	.5316
		Hyperdivergent	.45633*	.12564	.002	.1423	.7704
	Hyperdivergent	Normodivergent	-.22089	.09213	.063	-.4512	.0094
		Hypodivergent	-.45633*	.12564	.002	-.7704	-.1423
BB1M	Normodivergent	Hypodivergent	-.13750	.18263	.754	-.5940	.3190
		Hyperdivergent	.12920	.14203	.663	-.2258	.4842
	Hypodivergent	Normodivergent	.13750	.18263	.754	-.3190	.5940
		Hyperdivergent	.26670	.19369	.392	-.2175	.7509
	Hyperdivergent	Normodivergent	-.12920	.14203	.663	-.4842	.2258
		Hypodivergent	-.26670	.19369	.392	-.7509	.2175
BHT1M	Normodivergent	Hypodivergent	-.48232	.82957	.845	-2.5559	1.5912
		Hyperdivergent	.01024	.64515	1.000	-1.6024	1.6228
	Hypodivergent	Normodivergent	.48232	.82957	.845	-1.5912	2.5559

		Hyperdivergent	.49257	.87982	.855	-1.7066	2.6917
	Hyperdivergent	Normodivergent	-.01024	.64515	1.000	-1.6228	1.6024
		Hypodivergent	-.49257	.87982	.855	-2.6917	1.7066
BW131M	Normodivergent	Hypodivergent	-.15930	.47906	.946	-1.3567	1.0381
		Hyperdivergent	.65537	.37256	.220	-.2759	1.5866
	Hypodivergent	Normodivergent	.15930	.47906	.946	-1.0381	1.3567
		Hyperdivergent	.81467	.50807	.283	-.4553	2.0846
	Hyperdivergent	Normodivergent	-.65537	.37256	.220	-1.5866	.2759
		Hypodivergent	-.81467	.50807	.283	-2.0846	.4553
BW231M	Normodivergent	Hypodivergent	-.33645	.55486	.832	-1.7234	1.0505
		Hyperdivergent	.12785	.43151	.957	-.9507	1.2064
	Hypodivergent	Normodivergent	.33645	.55486	.832	-1.0505	1.7234
		Hyperdivergent	.46430	.58846	.734	-1.0066	1.9352
	Hyperdivergent	Normodivergent	-.12785	.43151	.957	-1.2064	.9507
		Hypodivergent	-.46430	.58846	.734	-1.9352	1.0066
TIncl1M	Normodivergent	Hypodivergent	-.2368	1.7596	.991	-4.635	4.161
		Hyperdivergent	1.0052	1.3684	.764	-2.415	4.426
	Hypodivergent	Normodivergent	.2368	1.7596	.991	-4.161	4.635
		Hyperdivergent	1.2420	1.8661	.802	-3.423	5.907
	Hyperdivergent	Normodivergent	-1.0052	1.3684	.764	-4.426	2.415
		Hypodivergent	-1.2420	1.8661	.802	-5.907	3.423
BIncl1M	Normodivergent	Hypodivergent	-.8294	1.5808	.872	-4.781	3.122
		Hyperdivergent	1.8929	1.2294	.312	-1.180	4.966
	Hypodivergent	Normodivergent	.8294	1.5808	.872	-3.122	4.781
		Hyperdivergent	2.7223	1.6765	.274	-1.468	6.913
	Hyperdivergent	Normodivergent	-1.8929	1.2294	.312	-4.966	1.180
		Hypodivergent	-2.7223	1.6765	.274	-6.913	1.468
CBB132P	Normodivergent	Hypodivergent	-.41640*	.11691	.003	-.7086	-.1242
		Hyperdivergent	.24346*	.09092	.033	.0162	.4707
	Hypodivergent	Normodivergent	.41640*	.11691	.003	.1242	.7086
		Hyperdivergent	.65987*	.12399	.000	.3499	.9698
	Hyperdivergent	Normodivergent	-.24346*	.09092	.033	-.4707	-.0162
		Hypodivergent	-.65987*	.12399	.000	-.9698	-.3499
CBB232P	Normodivergent	Hypodivergent	-.21307	.09658	.095	-.4545	.0283
		Hyperdivergent	.20406*	.07511	.030	.0163	.3918
	Hypodivergent	Normodivergent	.21307	.09658	.095	-.0283	.4545
		Hyperdivergent	.41713*	.10242	.001	.1611	.6732
	Hyperdivergent	Normodivergent	-.20406*	.07511	.030	-.3918	-.0163
		Hypodivergent	-.41713*	.10242	.001	-.6732	-.1611
CLB132P	Normodivergent	Hypodivergent	-.27154	.14857	.195	-.6429	.0998
		Hyperdivergent	.18403	.11554	.287	-.1048	.4728
	Hypodivergent	Normodivergent	.27154	.14857	.195	-.0998	.6429
		Hyperdivergent	.45557*	.15757	.019	.0617	.8494
	Hyperdivergent	Normodivergent	-.18403	.11554	.287	-.4728	.1048
		Hypodivergent	-.45557*	.15757	.019	-.8494	-.0617
CLB232P	Normodivergent	Hypodivergent	-.26167	.13283	.151	-.5937	.0704
		Hyperdivergent	.27320*	.10330	.036	.0150	.5314
	Hypodivergent	Normodivergent	.26167	.13283	.151	-.0704	.5937
		Hyperdivergent	.53487*	.14088	.001	.1827	.8870
	Hyperdivergent	Normodivergent	-.27320*	.10330	.036	-.5314	-.0150
		Hypodivergent	-.53487*	.14088	.001	-.8870	-.1827
BB2P	Normodivergent	Hypodivergent	-.08219	.19544	.915	-.5707	.4063
		Hyperdivergent	.27867	.15199	.193	-.1012	.6586
	Hypodivergent	Normodivergent	.08219	.19544	.915	-.4063	.5707
		Hyperdivergent	.36087	.20728	.227	-.1572	.8790
	Hyperdivergent	Normodivergent	-.27867	.15199	.193	-.6586	.1012
		Hypodivergent	-.36087	.20728	.227	-.8790	.1572
BHT2P	Normodivergent	Hypodivergent	.46737	.82531	.852	-1.5955	2.5303
		Hyperdivergent	-.39083	.64183	.831	-1.9951	1.2135
	Hypodivergent	Normodivergent	-.46737	.82531	.852	-2.5303	1.5955
		Hyperdivergent	-.85820	.87529	.620	-3.0460	1.3296
	Hyperdivergent	Normodivergent	.39083	.64183	.831	-1.2135	1.9951
		Hypodivergent	.85820	.87529	.620	-1.3296	3.0460

BW132P	Normodivergent	Hypodivergent	-.37456	.54807	.792	-1.7445	.9954
		Hyperdivergent	.84111	.42623	.150	-.2243	1.9065
	Hypodivergent	Normodivergent	.37456	.54807	.792	-.9954	1.7445
		Hyperdivergent	1.21567	.58127	.120	-.2372	2.6686
	Hyperdivergent	Normodivergent	-.84111	.42623	.150	-1.9065	.2243
		Hypodivergent	-1.21567	.58127	.120	-2.6686	.2372
BW232P	Normodivergent	Hypodivergent	-.46873	.57241	.716	-1.8995	.9620
		Hyperdivergent	.20751	.44516	.897	-.9052	1.3202
	Hypodivergent	Normodivergent	.46873	.57241	.716	-.9620	1.8995
		Hyperdivergent	.67623	.60708	.541	-.8412	2.1937
	Hyperdivergent	Normodivergent	-.20751	.44516	.897	-1.3202	.9052
		Hypodivergent	-.67623	.60708	.541	-2.1937	.8412
TIncl2P	Normodivergent	Hypodivergent	-1.5649	2.0152	.741	-6.602	3.472
		Hyperdivergent	3.5184	1.5672	.088	-.399	7.436
	Hypodivergent	Normodivergent	1.5649	2.0152	.741	-3.472	6.602
		Hyperdivergent	5.0833	2.1373	.066	-.259	10.426
	Hyperdivergent	Normodivergent	-3.5184	1.5672	.088	-7.436	.399
		Hypodivergent	-5.0833	2.1373	.066	-10.426	.259
BIncl2P	Normodivergent	Hypodivergent	-.9803	1.4288	.791	-4.552	2.591
		Hyperdivergent	.7027	1.1112	.819	-2.075	3.480
	Hypodivergent	Normodivergent	.9803	1.4288	.791	-2.591	4.552
		Hyperdivergent	1.6830	1.5154	.543	-2.105	5.471
	Hyperdivergent	Normodivergent	-.7027	1.1112	.819	-3.480	2.075
		Hypodivergent	-1.6830	1.5154	.543	-5.471	2.105
CBB13CI	Normodivergent	Hypodivergent	-.41535*	.08462	.000	-.6269	-.2038
		Hyperdivergent	.17072*	.06581	.040	.0062	.3352
	Hypodivergent	Normodivergent	.41535*	.08462	.000	.2038	.6269
		Hyperdivergent	.58607*	.08975	.000	.3617	.8104
	Hyperdivergent	Normodivergent	-.17072*	.06581	.040	-.3352	-.0062
		Hypodivergent	-.58607*	.08975	.000	-.8104	-.3617
CBB23CI	Normodivergent	Hypodivergent	-.20781	.12328	.248	-.5160	.1003
		Hyperdivergent	.21153	.09587	.095	-.0281	.4512
	Hypodivergent	Normodivergent	.20781	.12328	.248	-.1003	.5160
		Hyperdivergent	.41933*	.13075	.008	.0925	.7461
	Hyperdivergent	Normodivergent	-.21153	.09587	.095	-.4512	.0281
		Hypodivergent	-.41933*	.13075	.008	-.7461	-.0925
CLB13CI	Normodivergent	Hypodivergent	-.16741	.12811	.430	-.4876	.1528
		Hyperdivergent	.29002*	.09963	.018	.0410	.5391
	Hypodivergent	Normodivergent	.16741	.12811	.430	-.1528	.4876
		Hyperdivergent	.45743*	.13587	.005	.1178	.7971
	Hyperdivergent	Normodivergent	-.29002*	.09963	.018	-.5391	-.0410
		Hypodivergent	-.45743*	.13587	.005	-.7971	-.1178
CLB23CI	Normodivergent	Hypodivergent	-.67868*	.25948	.038	-1.3273	-.0301
		Hyperdivergent	.33972	.20180	.249	-.1647	.8441
	Hypodivergent	Normodivergent	.67868*	.25948	.038	.0301	1.3273
		Hyperdivergent	1.01840*	.27520	.002	.3305	1.7063
	Hyperdivergent	Normodivergent	-.33972	.20180	.249	-.8441	.1647
		Hypodivergent	-1.01840*	.27520	.002	-1.7063	-.3305
BBCI	Normodivergent	Hypodivergent	-.33566	.22282	.327	-.8926	.2213
		Hyperdivergent	-.09576	.17329	.859	-.5289	.3374
	Hypodivergent	Normodivergent	.33566	.22282	.327	-.2213	.8926
		Hyperdivergent	.23990	.23632	.600	-.3508	.8306
	Hyperdivergent	Normodivergent	.09576	.17329	.859	-.3374	.5289
		Hypodivergent	-.23990	.23632	.600	-.8306	.3508
BHTCI	Normodivergent	Hypodivergent	1.64833	1.00762	.269	-.8703	4.1670
		Hyperdivergent	-1.89760	.78362	.060	-3.8563	.0611
	Hypodivergent	Normodivergent	-1.64833	1.00762	.269	-4.1670	.8703
		Hyperdivergent	-3.54593*	1.06865	.006	-6.2171	-.8748
	Hyperdivergent	Normodivergent	1.89760	.78362	.060	-.0611	3.8563
		Hypodivergent	3.54593*	1.06865	.006	.8748	6.2171
BW13CI	Normodivergent	Hypodivergent	-1.25329*	.45093	.026	-2.3804	-.1262
		Hyperdivergent	.94381*	.35068	.032	.0673	1.8204
	Hypodivergent	Normodivergent	1.25329*	.45093	.026	.1262	2.3804

		Hyperdivergent	2.19710*	.47824	.000	1.0017	3.3925
	Hyperdivergent	Normodivergent	-.94381*	.35068	.032	-1.8204	-.0673
		Hypodivergent	-2.19710*	.47824	.000	-3.3925	-1.0017
BW23CI	Normodivergent	Hypodivergent	-1.53452*	.60751	.047	-3.0530	-.0160
		Hyperdivergent	1.10352	.47245	.072	-.0774	2.2844
	Hypodivergent	Normodivergent	1.53452*	.60751	.047	.0160	3.0530
		Hyperdivergent	2.63803*	.64430	.001	1.0276	4.2485
	Hyperdivergent	Normodivergent	-1.10352	.47245	.072	-2.2844	.0774
		Hypodivergent	-2.63803*	.64430	.001	-4.2485	-1.0276
TInclCI	Normodivergent	Hypodivergent	-1.5658	2.4018	.809	-7.569	4.438
		Hyperdivergent	6.6502*	1.8679	.003	1.981	11.319
	Hypodivergent	Normodivergent	1.5658	2.4018	.809	-4.438	7.569
		Hyperdivergent	8.2160*	2.5473	.008	1.849	14.583
	Hyperdivergent	Normodivergent	-6.6502*	1.8679	.003	-11.319	-1.981
		Hypodivergent	-8.2160*	2.5473	.008	-14.583	-1.849
BInclCI	Normodivergent	Hypodivergent	.5965	1.9311	.953	-4.230	5.423
		Hyperdivergent	3.9812*	1.5018	.035	.227	7.735
	Hypodivergent	Normodivergent	-.5965	1.9311	.953	-5.423	4.230
		Hyperdivergent	3.3847	2.0481	.262	-1.735	8.504
	Hyperdivergent	Normodivergent	-3.9812*	1.5018	.035	-7.735	-.227
		Hypodivergent	-3.3847	2.0481	.262	-8.504	1.735

*. The mean difference is significant at the 0.05 level.

Age 16 to 18 Years (ANOVA)

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
CBB132M	Between Groups	1.325	2	.663	2.794	.077
	Within Groups	7.116	30	.237		
	Total	8.441	32			
CBB232M	Between Groups	.503	2	.252	.973	.389
	Within Groups	7.755	30	.259		
	Total	8.259	32			
CLB132M	Between Groups	3.044	2	1.522	6.801	.004
	Within Groups	6.715	30	.224		
	Total	9.759	32			
CLB232M	Between Groups	1.813	2	.907	8.370	.001
	Within Groups	3.250	30	.108		
	Total	5.063	32			
BB2M	Between Groups	4.022	2	2.011	4.238	.024
	Within Groups	14.234	30	.474		
	Total	18.256	32			
BHT2M	Between Groups	33.561	2	16.780	3.472	.044
	Within Groups	144.981	30	4.833		
	Total	178.542	32			
BW132M	Between Groups	2.546	2	1.273	.514	.603
	Within Groups	74.296	30	2.477		
	Total	76.842	32			
BW232M	Between Groups	1.501	2	.751	.340	.714
	Within Groups	66.147	30	2.205		

	Total	67.648	32			
TIncl2M	Between Groups	46.107	2	23.054	.573	.570
	Within Groups	1207.708	30	40.257		
	Total	1253.815	32			
BIncl2M	Between Groups	191.306	2	95.653	3.020	.064
	Within Groups	950.312	30	31.677		
	Total	1141.619	32			
CBB131M	Between Groups	4.768	2	2.384	8.563	.001
	Within Groups	8.352	30	.278		
	Total	13.121	32			
CBB231M	Between Groups	1.535	2	.768	3.353	.049
	Within Groups	6.867	30	.229		
	Total	8.402	32			
CLB131M	Between Groups	4.016	2	2.008	6.782	.004
	Within Groups	8.883	30	.296		
	Total	12.899	32			
CLB231M	Between Groups	1.332	2	.666	3.662	.038
	Within Groups	5.456	30	.182		
	Total	6.789	32			
BB1M	Between Groups	1.418	2	.709	1.681	.203
	Within Groups	12.658	30	.422		
	Total	14.077	32			
BHT1M	Between Groups	2.136	2	1.068	.155	.857
	Within Groups	207.238	30	6.908		
	Total	209.374	32			
BW131M	Between Groups	10.045	2	5.023	2.094	.141
	Within Groups	71.955	30	2.399		
	Total	82.000	32			
BW231M	Between Groups	1.019	2	.510	.201	.819
	Within Groups	76.128	30	2.538		
	Total	77.147	32			
TIncl1M	Between Groups	105.750	2	52.875	1.797	.183
	Within Groups	882.699	30	29.423		
	Total	988.449	32			
BIncl1M	Between Groups	46.190	2	23.095	.774	.470
	Within Groups	894.608	30	29.820		
	Total	940.799	32			
CBB132P	Between Groups	1.745	2	.872	5.482	.009
	Within Groups	4.774	30	.159		
	Total	6.519	32			
CBB232P	Between Groups	.633	2	.316	2.206	.128
	Within Groups	4.303	30	.143		
	Total	4.935	32			
CLB132P	Between Groups	.913	2	.456	2.481	.101
	Within Groups	5.518	30	.184		
	Total	6.431	32			
CLB232P	Between Groups	1.025	2	.512	4.053	.028

	Within Groups	3.793	30	.126		
	Total	4.818	32			
BB2P	Between Groups	2.749	2	1.374	2.294	.118
	Within Groups	17.978	30	.599		
	Total	20.726	32			
BHT2P	Between Groups	8.394	2	4.197	.665	.522
	Within Groups	189.470	30	6.316		
	Total	197.864	32			
BW132P	Between Groups	17.536	2	8.768	4.218	.024
	Within Groups	62.360	30	2.079		
	Total	79.895	32			
BW232P	Between Groups	1.590	2	.795	.404	.671
	Within Groups	58.998	30	1.967		
	Total	60.588	32			
TIncl2P	Between Groups	204.470	2	102.235	2.803	.077
	Within Groups	1094.377	30	36.479		
	Total	1298.847	32			
BIncl2P	Between Groups	17.803	2	8.902	.406	.670
	Within Groups	657.535	30	21.918		
	Total	675.339	32			
CBB13CI	Between Groups	1.153	2	.576	4.976	.014
	Within Groups	3.475	30	.116		
	Total	4.627	32			
CBB23CI	Between Groups	.007	2	.003	.024	.977
	Within Groups	4.265	30	.142		
	Total	4.272	32			
CLB13CI	Between Groups	.163	2	.081	.433	.653
	Within Groups	5.642	30	.188		
	Total	5.804	32			
CLB23CI	Between Groups	6.369	2	3.184	6.506	.004
	Within Groups	14.684	30	.489		
	Total	21.053	32			
BBCI	Between Groups	2.735	2	1.368	2.330	.115
	Within Groups	17.604	30	.587		
	Total	20.339	32			
BHTCI	Between Groups	40.512	2	20.256	2.198	.129
	Within Groups	276.467	30	9.216		
	Total	316.979	32			
BW13CI	Between Groups	22.730	2	11.365	5.530	.009
	Within Groups	61.660	30	2.055		
	Total	84.390	32			
BW23CI	Between Groups	68.786	2	34.393	9.363	.001
	Within Groups	110.198	30	3.673		
	Total	178.984	32			
TInclCI	Between Groups	687.270	2	343.635	6.040	.006
	Within Groups	1706.866	30	56.896		
	Total	2394.136	32			

BInclCI	Between Groups	364.263	2	182.131	6.261	.005
	Within Groups	872.745	30	29.091		
	Total	1237.007	32			

Age 16 to 18 Years (Scheffé)

Multiple Comparisons

Scheffe

Dependent Variable	(I) FaceTyp	(J) FaceTyp	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
CBB132M	Normodivergent	Hypodivergent	-.37063	.24544	.333	-1.0027	.2614
		Hyperdivergent	.14634	.20077	.768	-.3707	.6634
	Hypodivergent	Normodivergent	.37063	.24544	.333	-.2614	1.0027
		Hyperdivergent	.51697	.21872	.077	-.0463	1.0802
	Hyperdivergent	Normodivergent	-.14634	.20077	.768	-.6634	.3707
		Hypodivergent	-.51697	.21872	.077	-1.0802	.0463
CBB232M	Normodivergent	Hypodivergent	-.35746	.25623	.390	-1.0173	.3024
		Hyperdivergent	-.15301	.20960	.768	-.6928	.3867
	Hypodivergent	Normodivergent	.35746	.25623	.390	-.3024	1.0173
		Hyperdivergent	.20445	.22834	.673	-.3836	.7925
	Hyperdivergent	Normodivergent	.15301	.20960	.768	-.3867	.6928
		Hypodivergent	-.20445	.22834	.673	-.7925	.3836
CLB132M	Normodivergent	Hypodivergent	-.46921	.23842	.162	-1.0832	.1448
		Hyperdivergent	.30869	.19503	.300	-.1935	.8109
	Hypodivergent	Normodivergent	.46921	.23842	.162	-.1448	1.0832
		Hyperdivergent	.77790*	.21246	.004	.2308	1.3250
	Hyperdivergent	Normodivergent	-.30869	.19503	.300	-.8109	.1935
		Hypodivergent	-.77790*	.21246	.004	-1.3250	-.2308
CLB232M	Normodivergent	Hypodivergent	-.50603*	.16586	.017	-.9332	-.0789
		Hyperdivergent	.09111	.13567	.799	-.2583	.4405
	Hypodivergent	Normodivergent	.50603*	.16586	.017	.0789	.9332
		Hyperdivergent	.59714*	.14780	.001	.2165	.9778
	Hyperdivergent	Normodivergent	-.09111	.13567	.799	-.4405	.2583
		Hypodivergent	-.59714*	.14780	.001	-.9778	-.2165
BB2M	Normodivergent	Hypodivergent	-1.01032*	.34713	.024	-1.9043	-.1164
		Hyperdivergent	-.45948	.28395	.285	-1.1907	.2718
	Hypodivergent	Normodivergent	1.01032*	.34713	.024	.1164	1.9043
		Hyperdivergent	.55084	.30934	.222	-.2458	1.3475
	Hyperdivergent	Normodivergent	.45948	.28395	.285	-.2718	1.1907
		Hypodivergent	-.55084	.30934	.222	-1.3475	.2458
BHT2M	Normodivergent	Hypodivergent	-1.73873	1.10786	.306	-4.5917	1.1142
		Hyperdivergent	.86026	.90623	.642	-1.4735	3.1940
	Hypodivergent	Normodivergent	1.73873	1.10786	.306	-1.1142	4.5917
		Hyperdivergent	2.59899*	.98725	.044	.0566	5.1414
	Hyperdivergent	Normodivergent	-.86026	.90623	.642	-3.1940	1.4735
		Hypodivergent	-2.59899*	.98725	.044	-5.1414	-.0566
BW132M	Normodivergent	Hypodivergent	-.02270	.79307	1.000	-2.0650	2.0196
		Hyperdivergent	.54562	.64873	.705	-1.1250	2.2162
	Hypodivergent	Normodivergent	.02270	.79307	1.000	-2.0196	2.0650
		Hyperdivergent	.56832	.70673	.726	-1.2517	2.3883
	Hyperdivergent	Normodivergent	-.54562	.64873	.705	-2.2162	1.1250
		Hypodivergent	-.56832	.70673	.726	-2.3883	1.2517
BW232M	Normodivergent	Hypodivergent	.24444	.74831	.948	-1.6826	2.1715
		Hyperdivergent	-.28497	.61212	.898	-1.8613	1.2914
	Hypodivergent	Normodivergent	-.24444	.74831	.948	-2.1715	1.6826
		Hyperdivergent	-.52941	.66685	.732	-2.2467	1.1878
	Hyperdivergent	Normodivergent	.28497	.61212	.898	-1.2914	1.8613

		Hypodivergent	.52941	.66685	.732	-1.1878	2.2467
TIncl2M	Normodivergent	Hypodivergent	-.8429	3.1975	.966	-9.077	7.391
		Hyperdivergent	1.9235	2.6155	.765	-4.812	8.659
	Hypodivergent	Normodivergent	.8429	3.1975	.966	-7.391	9.077
		Hyperdivergent	2.7664	2.8494	.629	-4.571	10.104
	Hyperdivergent	Normodivergent	-1.9235	2.6155	.765	-8.659	4.812
		Hypodivergent	-2.7664	2.8494	.629	-10.104	4.571
BIncl2M	Normodivergent	Hypodivergent	-.1238	2.8364	.999	-7.428	7.180
		Hyperdivergent	4.7627	2.3201	.139	-1.212	10.738
	Hypodivergent	Normodivergent	.1238	2.8364	.999	-7.180	7.428
		Hyperdivergent	4.8866	2.5276	.172	-1.622	11.396
	Hyperdivergent	Normodivergent	-4.7627	2.3201	.139	-10.738	1.212
		Hypodivergent	-4.8866	2.5276	.172	-11.396	1.622
CBB131M	Normodivergent	Hypodivergent	-1.00778*	.26591	.003	-1.6926	-.3230
		Hyperdivergent	-.13542	.21751	.825	-.6956	.4247
	Hypodivergent	Normodivergent	1.00778*	.26591	.003	.3230	1.6926
		Hyperdivergent	.87235*	.23696	.004	.2621	1.4826
	Hyperdivergent	Normodivergent	.13542	.21751	.825	-.4247	.6956
		Hypodivergent	-.87235*	.23696	.004	-1.4826	-.2621
CBB231M	Normodivergent	Hypodivergent	-.59730	.24111	.061	-1.2182	.0236
		Hyperdivergent	-.13562	.19723	.791	-.6435	.3723
	Hypodivergent	Normodivergent	.59730	.24111	.061	-.0236	1.2182
		Hyperdivergent	.46168	.21486	.117	-.0916	1.0150
	Hyperdivergent	Normodivergent	.13562	.19723	.791	-.3723	.6435
		Hypodivergent	-.46168	.21486	.117	-1.0150	.0916
CLB131M	Normodivergent	Hypodivergent	-.83698*	.27422	.017	-1.5432	-.1308
		Hyperdivergent	.02444	.22431	.994	-.5532	.6021
	Hypodivergent	Normodivergent	.83698*	.27422	.017	.1308	1.5432
		Hyperdivergent	.86143*	.24437	.006	.2321	1.4907
	Hyperdivergent	Normodivergent	-.02444	.22431	.994	-.6021	.5532
		Hypodivergent	-.86143*	.24437	.006	-1.4907	-.2321
CLB231M	Normodivergent	Hypodivergent	-.45508	.21492	.124	-1.0086	.0984
		Hyperdivergent	.05131	.17581	.958	-.4014	.5040
	Hypodivergent	Normodivergent	.45508	.21492	.124	-.0984	1.0086
		Hyperdivergent	.50639*	.19153	.043	.0132	.9996
	Hyperdivergent	Normodivergent	-.05131	.17581	.958	-.5040	.4014
		Hypodivergent	-.50639*	.19153	.043	-.9996	-.0132
BB1M	Normodivergent	Hypodivergent	-.58794	.32735	.216	-1.4309	.2551
		Hyperdivergent	-.34046	.26777	.455	-1.0300	.3491
	Hypodivergent	Normodivergent	.58794	.32735	.216	-.2551	1.4309
		Hyperdivergent	.24748	.29172	.701	-.5037	.9987
	Hyperdivergent	Normodivergent	.34046	.26777	.455	-.3491	1.0300
		Hypodivergent	-.24748	.29172	.701	-.9987	.5037
BHT1M	Normodivergent	Hypodivergent	-.70889	1.32454	.867	-4.1198	2.7021
		Hyperdivergent	-.17183	1.08347	.988	-2.9620	2.6183
	Hypodivergent	Normodivergent	.70889	1.32454	.867	-2.7021	4.1198
		Hyperdivergent	.53706	1.18034	.902	-2.5025	3.5767
	Hyperdivergent	Normodivergent	.17183	1.08347	.988	-2.6183	2.9620
		Hypodivergent	-.53706	1.18034	.902	-3.5767	2.5025
BW131M	Normodivergent	Hypodivergent	-.32889	.78048	.915	-2.3388	1.6810
		Hyperdivergent	.93641	.63843	.354	-.7077	2.5805
	Hypodivergent	Normodivergent	.32889	.78048	.915	-1.6810	2.3388
		Hyperdivergent	1.26529	.69551	.208	-.5258	3.0564
	Hyperdivergent	Normodivergent	-.93641	.63843	.354	-2.5805	.7077
		Hypodivergent	-1.26529	.69551	.208	-3.0564	.5258
BW231M	Normodivergent	Hypodivergent	-.50762	.80279	.820	-2.5750	1.5597
		Hyperdivergent	-.19804	.65668	.956	-1.8891	1.4930
	Hypodivergent	Normodivergent	.50762	.80279	.820	-1.5597	2.5750
		Hyperdivergent	.30958	.71539	.911	-1.5327	2.1519
	Hyperdivergent	Normodivergent	.19804	.65668	.956	-1.4930	1.8891
		Hypodivergent	-.30958	.71539	.911	-2.1519	1.5327
TIncl1M	Normodivergent	Hypodivergent	-2.8143	2.7336	.594	-9.854	4.225
		Hyperdivergent	1.7765	2.2361	.732	-3.982	7.535

	Hypodivergent	Normodivergent	2.8143	2.7336	.594	-4.225	9.854
		Hyperdivergent	4.5908	2.4360	.187	-1.682	10.864
	Hyperdivergent	Normodivergent	-1.7765	2.2361	.732	-7.535	3.982
		Hypodivergent	-4.5908	2.4360	.187	-10.864	1.682
BIncl1M	Normodivergent	Hypodivergent	-1.1413	2.7520	.918	-8.228	5.946
		Hyperdivergent	1.7327	2.2511	.746	-4.064	7.530
	Hypodivergent	Normodivergent	1.1413	2.7520	.918	-5.946	8.228
		Hyperdivergent	2.8739	2.4524	.511	-3.441	9.189
	Hyperdivergent	Normodivergent	-1.7327	2.2511	.746	-7.530	4.064
		Hypodivergent	-2.8739	2.4524	.511	-9.189	3.441
CBB132P	Normodivergent	Hypodivergent	-.37968	.20104	.185	-.8974	.1380
		Hyperdivergent	.21183	.16445	.446	-.2117	.6353
	Hypodivergent	Normodivergent	.37968	.20104	.185	-.1380	.8974
		Hyperdivergent	.59151*	.17915	.010	.1302	1.0529
	Hyperdivergent	Normodivergent	-.21183	.16445	.446	-.6353	.2117
		Hypodivergent	-.59151*	.17915	.010	-1.0529	-.1302
CBB232P	Normodivergent	Hypodivergent	-.36619	.19085	.176	-.8577	.1253
		Hyperdivergent	-.04745	.15611	.955	-.4495	.3546
	Hypodivergent	Normodivergent	.36619	.19085	.176	-.1253	.8577
		Hyperdivergent	.31874	.17007	.190	-.1192	.7567
	Hyperdivergent	Normodivergent	.04745	.15611	.955	-.3546	.4495
		Hypodivergent	-.31874	.17007	.190	-.7567	.1192
CLB132P	Normodivergent	Hypodivergent	-.36365	.21614	.259	-.9203	.1930
		Hyperdivergent	.05895	.17680	.946	-.3963	.5143
	Hypodivergent	Normodivergent	.36365	.21614	.259	-.1930	.9203
		Hyperdivergent	.42261	.19261	.107	-.0734	.9186
	Hyperdivergent	Normodivergent	-.05895	.17680	.946	-.5143	.3963
		Hypodivergent	-.42261	.19261	.107	-.9186	.0734
CLB232P	Normodivergent	Hypodivergent	-.41190	.17919	.088	-.8734	.0495
		Hyperdivergent	.02784	.14658	.982	-.3496	.4053
	Hypodivergent	Normodivergent	.41190	.17919	.088	-.0495	.8734
		Hyperdivergent	.43975*	.15968	.034	.0285	.8510
	Hyperdivergent	Normodivergent	-.02784	.14658	.982	-.4053	.3496
		Hypodivergent	-.43975*	.15968	.034	-.8510	-.0285
BB2P	Normodivergent	Hypodivergent	-.76206	.39012	.166	-1.7667	.2426
		Hyperdivergent	-.09660	.31911	.955	-.9184	.7252
	Hypodivergent	Normodivergent	.76206	.39012	.166	-.2426	1.7667
		Hyperdivergent	.66546	.34765	.178	-.2298	1.5607
	Hyperdivergent	Normodivergent	.09660	.31911	.955	-.7252	.9184
		Hypodivergent	-.66546	.34765	.178	-1.5607	.2298
BHT2P	Normodivergent	Hypodivergent	-1.40444	1.26648	.547	-4.6659	1.8570
		Hyperdivergent	-.89033	1.03598	.694	-3.5582	1.7775
	Hypodivergent	Normodivergent	1.40444	1.26648	.547	-1.8570	4.6659
		Hyperdivergent	.51412	1.12860	.902	-2.3923	3.4205
	Hyperdivergent	Normodivergent	.89033	1.03598	.694	-1.7775	3.5582
		Hypodivergent	-.51412	1.12860	.902	-3.4205	2.3923
BW132P	Normodivergent	Hypodivergent	.46698	.72658	.815	-1.4041	2.3381
		Hyperdivergent	1.62673*	.59434	.035	.0962	3.1573
	Hypodivergent	Normodivergent	-.46698	.72658	.815	-2.3381	1.4041
		Hyperdivergent	1.15975	.64748	.218	-.5076	2.8271
	Hyperdivergent	Normodivergent	-1.62673*	.59434	.035	-3.1573	-.0962
		Hypodivergent	-1.15975	.64748	.218	-2.8271	.5076
BW232P	Normodivergent	Hypodivergent	-.17413	.70672	.970	-1.9941	1.6458
		Hyperdivergent	.34621	.57810	.837	-1.1425	1.8349
	Hypodivergent	Normodivergent	.17413	.70672	.970	-1.6458	1.9941
		Hyperdivergent	.52034	.62978	.714	-1.1015	2.1422
	Hyperdivergent	Normodivergent	-.34621	.57810	.837	-1.8349	1.1425
		Hypodivergent	-.52034	.62978	.714	-2.1422	1.1015
TIncl2P	Normodivergent	Hypodivergent	.5206	3.0438	.985	-7.318	8.359
		Hyperdivergent	5.1954	2.4898	.131	-1.216	11.607
	Hypodivergent	Normodivergent	-.5206	3.0438	.985	-8.359	7.318
		Hyperdivergent	4.6748	2.7124	.243	-2.310	11.660
	Hyperdivergent	Normodivergent	-5.1954	2.4898	.131	-11.607	1.216

		Hypodivergent	-4.6748	2.7124	.243	-11.660	2.310
BIncl2P	Normodivergent	Hypodivergent	-.3270	2.3593	.990	-6.403	5.749
		Hyperdivergent	1.3092	1.9299	.796	-3.661	6.279
	Hypodivergent	Normodivergent	.3270	2.3593	.990	-5.749	6.403
		Hyperdivergent	1.6361	2.1025	.741	-3.778	7.050
	Hyperdivergent	Normodivergent	-1.3092	1.9299	.796	-6.279	3.661
		Hypodivergent	-1.6361	2.1025	.741	-7.050	3.778
CBB13CI	Normodivergent	Hypodivergent	-.51651*	.17151	.019	-.9582	-.0748
		Hyperdivergent	-.11458	.14029	.719	-.4759	.2467
	Hypodivergent	Normodivergent	.51651*	.17151	.019	.0748	.9582
		Hyperdivergent	.40193*	.15284	.045	.0083	.7955
	Hyperdivergent	Normodivergent	.11458	.14029	.719	-.2467	.4759
		Hypodivergent	-.40193*	.15284	.045	-.7955	-.0083
CBB23CI	Normodivergent	Hypodivergent	-.01175	.19001	.998	-.5011	.4776
		Hyperdivergent	.02229	.15543	.990	-.3780	.4225
	Hypodivergent	Normodivergent	.01175	.19001	.998	-.4776	.5011
		Hyperdivergent	.03403	.16933	.980	-.4020	.4701
	Hyperdivergent	Normodivergent	-.02229	.15543	.990	-.4225	.3780
		Hypodivergent	-.03403	.16933	.980	-.4701	.4020
CLB13CI	Normodivergent	Hypodivergent	-.01889	.21854	.996	-.5817	.5439
		Hyperdivergent	.13170	.17876	.764	-.3287	.5921
	Hypodivergent	Normodivergent	.01889	.21854	.996	-.5439	.5817
		Hyperdivergent	.15059	.19475	.744	-.3509	.6521
	Hyperdivergent	Normodivergent	-.13170	.17876	.764	-.5921	.3287
		Hypodivergent	-.15059	.19475	.744	-.6521	.3509
CLB23CI	Normodivergent	Hypodivergent	-.81302	.35258	.087	-1.7210	.0949
		Hyperdivergent	.32026	.28841	.547	-.4224	1.0630
	Hypodivergent	Normodivergent	.81302	.35258	.087	-.0949	1.7210
		Hyperdivergent	1.13328*	.31419	.005	.3242	1.9424
	Hyperdivergent	Normodivergent	-.32026	.28841	.547	-1.0630	.4224
		Hypodivergent	-1.13328*	.31419	.005	-1.9424	-.3242
BBCI	Normodivergent	Hypodivergent	-.63905	.38604	.270	-1.6332	.3551
		Hyperdivergent	.09020	.31578	.960	-.7230	.9034
	Hypodivergent	Normodivergent	.63905	.38604	.270	-.3551	1.6332
		Hyperdivergent	.72924	.34401	.123	-.1567	1.6151
	Hyperdivergent	Normodivergent	-.09020	.31578	.960	-.9034	.7230
		Hypodivergent	-.72924	.34401	.123	-1.6151	.1567
BHTCI	Normodivergent	Hypodivergent	-.73921	1.52986	.890	-4.6789	3.2005
		Hyperdivergent	-2.48072	1.25142	.158	-5.7034	.7419
	Hypodivergent	Normodivergent	.73921	1.52986	.890	-3.2005	4.6789
		Hyperdivergent	-1.74151	1.36331	.452	-5.2523	1.7693
	Hyperdivergent	Normodivergent	2.48072	1.25142	.158	-.7419	5.7034
		Hypodivergent	1.74151	1.36331	.452	-1.7693	5.2523
BW13CI	Normodivergent	Hypodivergent	-.12841	.72249	.984	-1.9890	1.7321
		Hyperdivergent	1.60209*	.59099	.037	.0802	3.1240
	Hypodivergent	Normodivergent	.12841	.72249	.984	-1.7321	1.9890
		Hyperdivergent	1.73050*	.64383	.039	.0725	3.3885
	Hyperdivergent	Normodivergent	-1.60209*	.59099	.037	-3.1240	-.0802
		Hypodivergent	-1.73050*	.64383	.039	-3.3885	-.0725
BW23CI	Normodivergent	Hypodivergent	-2.42302	.96586	.057	-4.9103	.0643
		Hyperdivergent	1.29379	.79007	.277	-.7408	3.3284
	Hypodivergent	Normodivergent	2.42302	.96586	.057	-.0643	4.9103
		Hyperdivergent	3.71681*	.86071	.001	1.5003	5.9333
	Hyperdivergent	Normodivergent	-1.29379	.79007	.277	-3.3284	.7408
		Hypodivergent	-3.71681*	.86071	.001	-5.9333	-1.5003
TInclCI	Normodivergent	Hypodivergent	-4.5222	3.8013	.501	-14.311	5.267
		Hyperdivergent	6.6013	3.1094	.123	-1.406	14.609
	Hypodivergent	Normodivergent	4.5222	3.8013	.501	-5.267	14.311
		Hyperdivergent	11.1235*	3.3874	.010	2.400	19.847
	Hyperdivergent	Normodivergent	-6.6013	3.1094	.123	-14.609	1.406
		Hypodivergent	-11.1235*	3.3874	.010	-19.847	-2.400
BInclCI	Normodivergent	Hypodivergent	-6.5444	2.7181	.071	-13.544	.455
		Hyperdivergent	2.0085	2.2234	.669	-3.717	7.734

	Hypodivergent	Normodivergent	.5444	2.7181	.071	-.455	13.544
		Hyperdivergent	8.5529*	2.4222	.005	2.315	14.791
	Hyperdivergent	Normodivergent	-2.0085	2.2234	.669	-7.734	3.717
		Hypodivergent	-8.5529*	2.4222	.005	-14.791	-2.315

*. The mean difference is significant at the 0.05 level.

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