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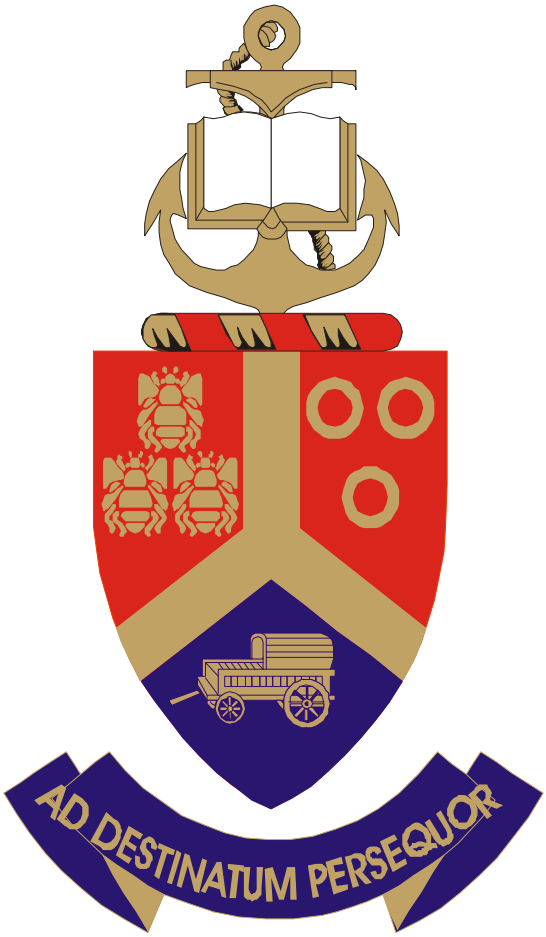
SOFT TISSUE FACIAL PROFILE ASSESSMENT OF 15-20 YEAR OLD TSWANA SUBJECTS



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by

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DEDICATION

This dissertation is dedicated in memory of my loving sister Noma-Afrika Mzizana whose courage and strong zeal I admired.

ACKNOWLEDGEMENTS

I wish to extend my gratitude to the following people who have made the presentation of this dissertation possible:

Firstly I thank the Almighty whose love and strength gave me the courage and perseverance to undertake and complete this research, for I can do all things through Christ who strengthens me- Philippians 4:13 – Ref. King James Version

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To the principals, teachers and pupils, my sincere thanks for your time and commitment to this project.

DECLARATION

I, Nondumiso Yvonne Helen Mzizana hereby declare that the work on which this dissertation is based, is original (except where acknowledgements indicate otherwise) and that neither the whole, nor any part of it has been, or shall be submitted at another university, institution or tertiary education or examining body.

The work reported in the dissertation was performed in the Department of Orthodontics, Faculty of Health Sciences, School of Dentistry, University of Pretoria, Pretoria, Republic of South Africa.

All opinions or statements expressed in this dissertation do not necessarily reflect that of the University of Pretoria, the Supervisor of the dissertation or External Examiner.

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NYH Mzizana

SUMMARY

A well balanced and harmonious soft tissue profile is an important consideration in orthodontic diagnosis and treatment planning.

The purpose of this study was to determine the soft tissue profile norms in Tswana subjects, compare the results with those of other ethnic groups and develop soft tissue "norms" or standards which may be useful as guides for diagnosis and treatment planning for Tswana orthodontic patients in South Africa.

420 subjects between the ages of 15-20 were randomly selected from their schools at no criteria. 102 Tswana (52 female and 50 male) and 50 non-Tswana subjects (25 female and 25 male) were selected according to criteria. The subjects were selected for excellence of occlusion, balanced facial proportion, complete dentition (third molars disregarded) dental Class I occlusion with normal overbite and overjet, minimal spacing or crowding, no history of orthodontic treatment and no gross caries. Various orthodontic analyses were used to measure and determine soft tissue facial profiles in both Tswana and non-Tswana subjects.

Results were analysed statistically to determine the differences in facial profiles between Tswana and non-Tswana subjects and compare these to Caucasian and African-American norms. The results indicate that Tswana subjects had a flatter profile than non-Tswana subjects whose facial profiles were fuller. The study also indicates that the facial profile values established for Caucasian subjects are not applicable to Tswana and African-American subjects.

The findings of the present study showed that when planning orthodontic treatment for Tswana subjects it may be useful to perhaps take into account some measurements which may be more appropriate.

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CHAPTER 1

INTRODUCTION

As a beauty I'm not a great star. There are others more handsome by far.
But my face I don't mind it. Because I'm behind it – Tis the Folks out in front that I jar –

From : *Limeratomy by AE Ewer (1877 – 1942)*

Considerations of facial aesthetics always have been an inseparable part of the principles and practice of orthodontics. The early orthodontists applied an artistic ideal of dental occlusion as their model in correcting irregularities of the teeth and jaws in young growing patients. It therefore was natural for them to strive for artistic harmony and aesthetic improvement of the face also. Over the years clinical concepts of facial aesthetics have gradually shifted from the application of cultural ethnic based norms to the use of quantitative soft tissue diagnostic evaluations (Altemus, 1968).

Orthodontics has generally led the way in quantitative analysis of the soft tissue facial architecture, developing norms and longitudinal data, important equally to maxillofacial surgeons, plastic surgeons and to clinicians in prosthetic dentistry. Apart from the continuing attention received from clinical medicine, the face is now attracting serious study from diverse professions and is even becoming "big business" (Alcade *et al*, 2000).

Psychologists, anthropologists and computer engineers are doing some ingenious work in the field of facial recognition (Alexander & Hitchcock, 1978). They identify critical contours, patterns, and measurements of human faces and are uncovering some of the underlying mechanisms in the cerebral processing of visual information.

The introduction of cephalometric radiography in orthodontic diagnosis by Broadbent in 1931 inadvertently shifted the specialty's attention from the facial soft tissues to the skeletal structures. However, clinicians are aware of the fact that soft tissue changes are associated

with hard tissue changes. It has been shown that rigid adherence to the hard tissue norms results in neither facial balances and harmony, nor long term stability (Burstone, 1958). The primary goal of orthodontic treatment is harmonized facial structures. Balancing the position of the lips in relation to the nose and chin has a direct relationship to aesthetic preference (Ricketts, 1968).

Harmonious facial aesthetics and functional occlusion have long been recognised as two of the goals of orthodontic treatment. Soft tissue profile is one of the most critical areas of interest in the development and selection of a potential orthodontic treatment. The soft tissue profile has been studied extensively in orthodontics, primarily from lateral cephalometric radiographs, under the assumption that the form of soft tissue outline largely determines the aesthetics of the face. (Holdaway, 1983).

Soft tissue is the ultimate compensating factor in facial contour morphology, and since this is the case, a meaningful analysis of these tissues is necessary for adequate diagnosis and effective treatment planning. When conventional orthodontic procedures present limitations to achieve acceptable facial contours, it may even be justified to plan a surgical intervention to further enhance the treatment result.

The literature has numerous studies involving soft tissue facial profile of Caucasian subjects (Sutter & Turley, 1998), but very little reference is made to black subjects (Sushner, 1977). Standards of facial aesthetics have begun to change worldwide as technology has facilitated global communication. In more socially and ethnically diverse countries such as the United States, there appears to be a rebirth in ethnic pride (Thomas, 1980).

In South Africa there is a large black population who will surely come to demand more and more frequently, the type of aesthetic attention that is available through orthognathic and plastic reconstructive surgical procedures hence there is a need to establish data of facial patterns for the Tswana profiles. This will eliminate the use of Caucasian-based norms on subjects of African descent when diagnosing and treatment planning (Sushner, 1977). With an increasing number of patients of African descent seeking orthodontics and orthognathic surgery, it would be useful to the clinician to have soft tissue facial profile norms for

subjects of African descent to aid diagnosis and treatment planning. It is also important that lateral facial profiles relevant to particular ethnic groups should be available. A single standard of facial aesthetics and facial profile is possibly not appropriate for application to diverse facial and ethnic groups. In the present multicultural society, racial and ethnic differences are assuming an increasing level of importance. Currently metropolitan areas of the world have a more diverse population, bringing with it a need to recognise that a single standard of facial aesthetics may not be appropriate when making diagnostic and treatment planning decisions (Virolainen, 1967).

Usually, as the malocclusion is corrected, changes are brought in appearance that should be pleasing to all concerned. However most orthodontists who have practiced for years have had the unpleasant experience of finding that some subjects' faces looked better before the orthodontic corrections were made (Steiner, 1960). "The study of orthodontics is closely connected with that of art as related to the human face. The mouth is the most potent factor in creating or distorting the beauty and character of the face". These words written by Edward H Angle in 1907 prefaced a very comprehensive discussion of facial art as related to orthodontics. The orthodontic profession has passed beyond the era of being merely tooth straighteners. To stress the point still further, Edmund H Wuerpel 1937 gave a clue to the solution of acceptable standards for analysis of facial form when he said: "Beauty is the finest expression of human emotions….the art that was produced in the past has survived because it was expressed in the highest, finest, most sensitive manner possible. The beauty that survives knows no limits either of time or place. Each man's concept of beauty is a matter of his own innermost sensibility and understanding."

Herzberg & Benjamin (1952) have concluded that the majority of patients desire orthodontic services for two reasons namely, the presence of facial disharmony, or facial deformity and mal-alignment of the teeth, or both. It is known that the patient is little interested in the bony changes or the angulations of the teeth as exhibited in a cephalometric radiograph. The patient is decidedly interested in seeing an improvement in the protrusion of the lips, the curl of the lower lip, the apparent growth or forward displacement of the chin. What a crime it would be not to obtain such change if it is a possibility by orthodontic means.

The results of Bacon *et al*., (1983) were found to be significantly different from the Caucasian and non-Tswana norms which indicates that diagnosis and treatment planning should not be interchanged from one racial group to another without the consideration that correctly taken photographs of the profile may be used as diagnostic aids in determining the facial profile in racial norms for each group. Facial profiles and cephalometric analyses of Negroids, Caucasians and other groups have revealed that the norms and standards of a group cannot be used, without modification, in orthodontic treatment planning for another group (Cotton *et al.,* 1951; Altemus, 1968 and Jacobson *et al.,* 1978).

According to Bell *et al.,* (1980) orthognathic surgery done, often does not produce the desired facial aesthetics. This is partly due to the fact that the hard tissue supporting the soft tissues by no means reflects at 1:1 ratio post-surgery. Most analysis reported in the literature has concentrated on the dento-skeletal tissues but not all of these sephalometric analyses incorporated a soft tissue analysis.

Although there are other soft tissue measurements, the most commonly used are: the facial angle of Burstone (1967) which measures the convexity of a profile, the S-line of Steiner (1959) and E-Line of Ricketts (1968). These are the prevalent soft tissue measurements commonly used to analyse soft tissue profiles, and therefore they will be employed in this study as main reference measurements.

CHAPTER 2

LITERATURE REVIEW

2.1 BACKGROUND AND HISTORY

Judgement of facial aesthetics is subjective and is undoubtedly dependent on various cultural, social, geographic and psychological backgrounds of people. Orthodontists should consider these variables when establishing a diagnosis or formulating a treatment plan. Soft tissue analysis is the most critical means of interest in the development and selection of a potential orthodontic treatment plan (Mandall *et al.*, 1999).

Soft tissue profile has been studied extensively in orthodontics primarily from lateral cephalometric radiographs. The analysis of the soft tissue profile of the face was a concern for the pioneers of orthodontics such as Angle and Case at the end of the 19th and the beginning of the 20th centuries. Angle took the sculpture of Apollo Belvedere as his canon of corporal and facial beauty. However, its straight almost concave profile would be difficult to obtain orthodontically with Angle's non-extraction theory. He claimed that the correct occlusion of all teeth in both jaws was necessary to reach optimum facial appearance (Angle, 1907).

Angle illustrated the idealized view with the skull "Old Glory" as well as the neoclassical Greek sculpture of the head and face of Apollo Belvedere, ignoring the fact that the African skull with its perfectly aligned teeth was incompatible with the classic Greek-face (Angle, 1907). After standardization of the teleradiographic technique (Broadbent, 1931), analysis of the soft tissue facial profile was relegated in favour of dentoskeletal relationships.

Tweed (1944) gave special attention to aesthetics, using cephalometric standards in a cross-sectional study of 95 patients with good facial aesthetics. Following Tweed's article (1944) the 1950's saw a flourishing of research including cephalometric skeletal analysis and facial aesthetics.

Some authors such as Downs (1948) incorporated measurements of the soft tissue profile in the cephalometric analysis, introducing filters in the teleradiographical technique that allowed visualization of the soft tissues.

2.2 DIFFERENT SOFT TISSUE ANALYSIS

A review of the literature indicates that many soft tissue profile analyses are too complicated or require sophisticated equipment not readily available to the clinician, and in the present form are of little value as clinical tools. In addition, the analysis that appears to have the most clinical value has insufficient documentation of longitudinal changes, which might well affect the applicability of the analyses at different stages (Ricketts, 1960).

Steiner (1953) attempted to evaluate the soft tissue profile by drawing a line (S Line) from the middle of the S-shaped curve between the tip of the nose and subnasale to the soft tissue pogonion and stated that the lips should touch the reference line. When the lips fall anterior and posterior to the line, fullness or flatness was indicated respectively. He stated that this analysis is important, for it takes into consideration a large or small nose and a large or small chin and harmonize them with the lips.

Burstone (1958) suggested a very comprehensive soft tissue profile analysis. Contour angles are formed by intersecting lines connecting various profile components and these indicate the intricate morphology of the integumental profile. This B line was drawn from the soft tissue subnasale to soft tissue pogonion. In his study of 37 adult Caucasians he concluded that the upper and lower lips lie behind this line at a mean distance of 3.5 mm and 2.2 mm, respectively. He regarded the facial contour angle, glabella-subnasale-pogoinon measured to the straight line glabella-subnasale as the most important angle in soft tissue study. The average measurement is 11 ± 4 degrees for Caucasians. As the angle becomes less negative or even positive, this is indicative of a tendency towards a Class III.

Studies by Ricketts (1960 and 1968) revealed new methods at analysing soft tissue. Ricketts' (1968) lip analysis consisted of a line (E line) drawn from the tip of the nose to the soft tissue pogonion. He concluded that no ideal lip relationship was possible, but he recognised a range of normal lip relations. In a sample of adults the lower lip was found to be located at

a mean distance of 2mm posterior to the line, with a standard deviation of ± 3mm and the upper lip was found to be 4mm posterior. In patients of orthodontic ages of 13 to 14 years, a mean distance of 2.0mm with a standard deviation of ± 3mm for the lower lip behind the "E" plane was acceptable. He stated that most patients objected to lips that were anterior to this line, referred to as the "aesthetic plane".

In 1961, Ricketts used the golden divider in his morphology dentofacial analysis. He established divine or golden proportions (Ø = 1.618) among the different parts of the face (width of the nose/width of the mouth, length of the upper lip/nasal length and facial height). He modified Holdaway's H line by drawing a line which he called the "profile line" from soft tissue pogonion to the most procumbent lip. He also stated that, in a consideration of the chin to its relation to the face, it is important that the total chin be expressed. He also measured the bony chin lying anterior to the line NB by measuring to pogonion. He measured the integumentum overlying at the same point and found that the osseous chin and its soft tissue overlay varied greatly in individuals. He considered the overall evaluation of the total chin to be more important in a study of facial aesthetics than an evaluation of the bony chin alone.

A line (S2) which was drawn from soft tissue nasion to soft tissue pogonion was developed by Sushner (1977). He stated that the upper and lower lips were anterior to this line in the black population compared to the white population. This measurement of S line was 8.8mm/6.7mm in black females and 10.3mm/8mm in black males.

Burstone (1967) carried out an exhaustive aesthetic analysis of the facial profile. Within the linear parameters, he defined the position of the upper labriale superius and lower labriale inferius lips regarding the subnasale to pogonion line, the nasal length (measured perpendicular to the palatal plane), and the length of the upper subnasale to stomion and lower stomion to menton lips, and the interlabial gap upper stomion to lower stomion. The lip posture and its significance in treatment planning were studied by measuring the vertical and horizontal lip length along with interlabial gap distance. A method of direct integumental analysis by employing angular readings that described facial components to the skull as a whole (inclination angles) and to each other (contour angles) was also presented.

The Herron sample of 41 males (negroids), along with a grid, was used to study the soft tissue changes occurring during growth and treatment. Seven points were used on the soft tissue profile views, namely glabella, subnasale, superior labial sulcus, labial superius, labial inferius, inferior labial sulcus and menton. Connecting these points, inclinations and contour angles were devised. Through the use of cephalometrics, horizontal and vertical extensions of the soft tissue were measured from adjacent hard tissue profile.

Holdaway (1983) defined the Holdaway line with which he evaluated the subnasal position and the positions of the superior labial sulcus, the inferior labial sulcus, and the inferior lip. He also defined the nasal prominence and thickness of the upper lip at the level of A-point and the chin at pogonion. He described the soft tissue analysis using the Holdaway line tangent to upper lip from soft tissue pogonion when the ANB angle was 1º to 3º and the lower lip was on the H line and the tip of the nose was about 9mm anterior to this reference line. He stated that in an ideal case both the upper and lower lips were on the H-line, the proportions of the nose to the upper lip formed by a harmonious S-curve and the linear measurement from the tip of the nose to the Holdaway line. This study, even though widely used, was conducted on young Caucasians with a sample size of eighty patients.

Hambleton (1964) discussed several methods of evaluation of the soft tissue covering the skeletal face and decided that the Holdaway H angle was the most useful. This angle is formed by the intersection of the line NB to a straight line tangent to the soft tissue chin and the upper lip. He considered the Holdaway line most useful because it considers the foundation for soft tissue by its relationship to line NB and the angle ANB and because it was tangent to the upper lip, where he thought that orthodontic treatment was most effective.

Epker (1992) conducted a study on 50 young adult Caucasian patients where he recorded the natural head position, using the time vertical as the reference line on which he defined proportional measures, as the following: the upper lip subnasale to pogonion, the inferior lip stomion to subnasale was 28% of the inferior third of the face, the height of the chin was 42% of the inferior third, the nasal depth subnasale to pre nasale was 40% of the nasal length.

2.3 HISTORY ON SOFT TISSUE PROFILE PHOTOGRAPHIC STUDIES:

Neger (1959) studied the soft-tissue profile from photographs using six angular relationships between the upper lip, lower lip and chin. This study evaluated the clinical excellent occlusions with acceptable facial forms and other groups of malocclusions. It was found that a proportionate change in improvement of the soft tissue profile does not necessarily accompany extensive dentition changes and therefore, orthodontists can no longer rely entirely on a dento-skeletal analysis for accurate information on the soft-tissue facial profile changes which have occurred during orthodontic treatment. The attention was called to the need for recognising marked deficiencies in the pogonion area when correcting malocclusions, and the need for evaluating the soft tissue profile as a separate entity, apart from the dentoskeletal analysis, were recommended

Arnett and Bergman (1993) defined frontal and lateral analysis from the photographic records of young adult Caucasians taken in the natural head position. They used, among others, the nasolabial angle and the angle of the contour of the maxillary and mandibular sulcus. They also described the facial profile in Class I (165-175 degrees), Class II (< 165 degrees) and Class III profiles (> 175 degrees) according to the angle of the facial convexity (Gl-Sn-Pog). Their aim was to quantify average parameters that define the soft tissue profile.

2.4 PREVIOUS STUDIES ON SOFT TISSUE PROFILE RACIAL DIFFERENCES

Wuerpl (1937) stated that faces can be beautiful even though they are proportioned differently, the important factor is balance. He described balance by noting that one part of the facial pattern must not be overemphasised at the expense of another. He also discussed the necessity for the orthodontist to understand clearly what type of face he is dealing with, whether it is Greek, Roman, Semitic or Mongoloid. He stressed the importance of the length and direction of the line forming the upper lip from the end of the nose to the beginning of the lip because this line is considered important in the appearance of an individual. These early observations demonstrated a concern with finding or establishing a harmonious relationship between the mouth and facial features, however, no attempts were made to quantify the static facial patterns.

A study by Hrdlicka (1928) revealed some interesting racial differences. The face and mouth of the American black were larger than those of the American white, whereas the head and ears were smaller. The nose of the American black was broader, shorter, and flatter.

Altemus (1968) studied a group of 80 American black children and developed norms for the Downs' analysis. He found a greater absolute size of black children's heads and greater dental protrusion, with the chin in the same position relative to the cranial base, than in white children. In addition, he found that the lower facial height was relatively longer than the upper facial height, compared with white children. He further studied the integumental profile of black subjects and compared his results with those of Burstone (1967) in white subjects. He found, in general, a greater soft tissue thickness in black children than in Burstone's sample of 37 adults with average faces, except at subnasale where the soft tissue coverage over the anterior nasal spine was thinner.

Drummond (1968) compared Caucasians to American Negro's and showed the Negro patient to have a large, strong tongue and very loose, flaccid lips that allowed the teeth to be in balance and harmony in a procumbent position. The position of the teeth and the thickness of the lips made the lower face appear very full.

Altemus (1968) believed that cephalofacial features are the basis for anatomists and physical anthropologists to classify man into various racial stocks through the use of a variety of heads and faces (cephalofacial relationships). He found that it had not really been proved scientifically that orthognathic faces are more beautiful and healthy. He presented examples of cephalofacial relationships from the members of different racial and ethnic extractions and concluded that the relative straightness of the facial profile is a compromise in the relationship of its anatomic parts. Some of ethnic extractions closely resembled reference norms of other ethnic extractions.

De Smit and Dermaut (1984) reported Caucasians to have flatter profiles than the Negroid group. One group of Caucasian patients (40 female and 91 male) and another group of Black patients (49 females and 69 males) with an average mean range of 23 years was used.

Sushner (1977) studied 100 lateral photographs of attractive blacks. He compared the Steiner, Holdaway and Ricketts standards with the American Negroid profile. He concluded that the black American's soft tissue profile is significantly more protrusive than white profiles and that evaluation of black profiles should be made without imposing white standards.

Fonseca and Klein (1978) found that the nasal tip was slightly less prominent in black Americans than in whites, and this together with the protrusive lips gave the lower face a very convex appearance, more so than could be accounted for by the underlying hard tissue bimaxillary protrusion. They also evaluated black American women and concluded that the maxilla and mandible were more protrusive. The middle facial height appeared shorter, and the lower facial height was longer in the black sample than in a comparable white sample. Lip protrusion was greater, yet absolute lip thickness was not significantly greater in black than in white women.

Richardson (1980) compared the dimensional traits of the human face in several races including blacks. Upon analysing the literature, it becomes apparent that the hard and soft tissue norms of blacks differ from the white standards. However, the black norms are not complete when potential surgical cases were evaluated. He was of the opinion that ethnic differences in faces do exist, but he questioned the magnitude of such differences. He further believed that sampling techniques may have been responsible for the large variations noted between racial groups.

Thomas (1980) evaluated the soft tissue facial profile of the American black woman. He surveyed black members of the orthodontic speciality by using profile tracing of photographic profiles. The results showed that black and white orthodontists shared the same preference namely the straight profile with good facial balance and mild convexity.

De Smit and Dermaut (1984) confirmed with their findings that black Americans differ significantly from white Americans in dental, skeletal and soft tissue parameters. There appeared to be no agreement as to whether lay persons and professionals share common

aesthetic preferences. The studies that have tested the black American preference in judging themselves have shown them to prefer straighter profiles.

Connor and Moshiri (1985) compared a sample of 50 black adults with a sample of 50 white adults, both groups having Angle Class I occlusion. They presented norms for a variety of measurements from overall analyses, as did Fonseca and Klein (1978). They found greater maxillary and mandibular skeletal prognathism, anterior dental height, lower incisor proclination, upper lip length, and throat lengths in blacks than in whites. The nasolabial angle and lip-chin-throat angle were less in blacks than in whites. Male and female norms were also presented by the study of Fonseca and Klein (1978).

Similar studies by Guinn (1982) as well as Connor and Moshiri (1985) confirmed that the black soft tissue profile was more protrusive and differed significantly from white norms.

2.5 CONCLUSION

Judgement of facial aesthetics is subjective and is undoubtedly dependent on various cultural, social, geographic and psychological backgrounds of people. Orthodontists should consider these variables when establishing a diagnosis for formulating a treatment plan. Soft tissue analysis is the most critical means of interest in the development and selection of a potential orthodontic treatment plan.

According to Peck & Peck (1969) a person's background determines what types of facial features are found pleasing. The average must be considered a variant depending on individual ethnic or racial factors (Burstone, 1967).

Peck and Peck (1969) also determined the public's concept of pleasing facial aesthetics. The sample included professional models, beauty contest winners, and performing stars noted for their facial attractiveness. They concluded that the general public admires a fuller and more protrusive dentofacial pattern than the standard means of the Margolis (1943), Downs (1948) and Steiner (1960) analyses allowed.

In orthodontics, different authors have included soft tissue parameters in cephalometric analysis (Burstone, 1967; Subtelny, 1959; Lines *et al.,* 1978; Holdaway, 1983). Various soft tissue facial analyses based on photogrammetry have also been described (Stoner, 1955; Peck & Peck, 1969; Powell & Humphreys, 1984; Epker, 1992 and Arnett & Bergman, 1993 a, b).

All these studies indicated that normal measurements for one group should not be considered norms for every race or ethnic group. Different racial groups must be treated according to their own characteristics.

CHAPTER 3

AIM OF THIS STUDY

- The aim of this study was to establish lateral facial profile norms for Tswana subjects to facilitate accurate diagnosis for planning of orthodontic treatment.

- To compare the standards developed by Holdaway, Ricketts, Steiner and facial convexity from the soft tissue analyses of the Caucasian population and other ethnic groups to norms of the Tswana and non-Tswana subjects.

- To develop lateral facial "norms" or standards which may be useful as guides for diagnostic procedure and treatment planning for the Tswana orthodontic patients.

HYPOTHESIS

- The facial profile will not be different between Tswana and non Tswana subjects.

CHAPTER 4

MATERIALS AND METHODS

4.1 THE POPULATION

The black population of South Africa consists mainly of Tswana speaking people, Zulus, Xhosas, Shangaans and Venda speaking people. The Tswana speaking people of which this study is based, originate from Botswana and consists of three groups, namely the Sotho-Tswana, the Kalanga, and the San (Bushmen). The majority are the Sotho-Tswana and this group of people are now spread throughout Botswana, across the North West province, Free State, and Lesotho as shown in Fig. 4.1 (Tlou and Campbell, 1984). Schuring (1990) found the Sotho-Tswana speaking group to make up 23,59 percent of the total South African black population.

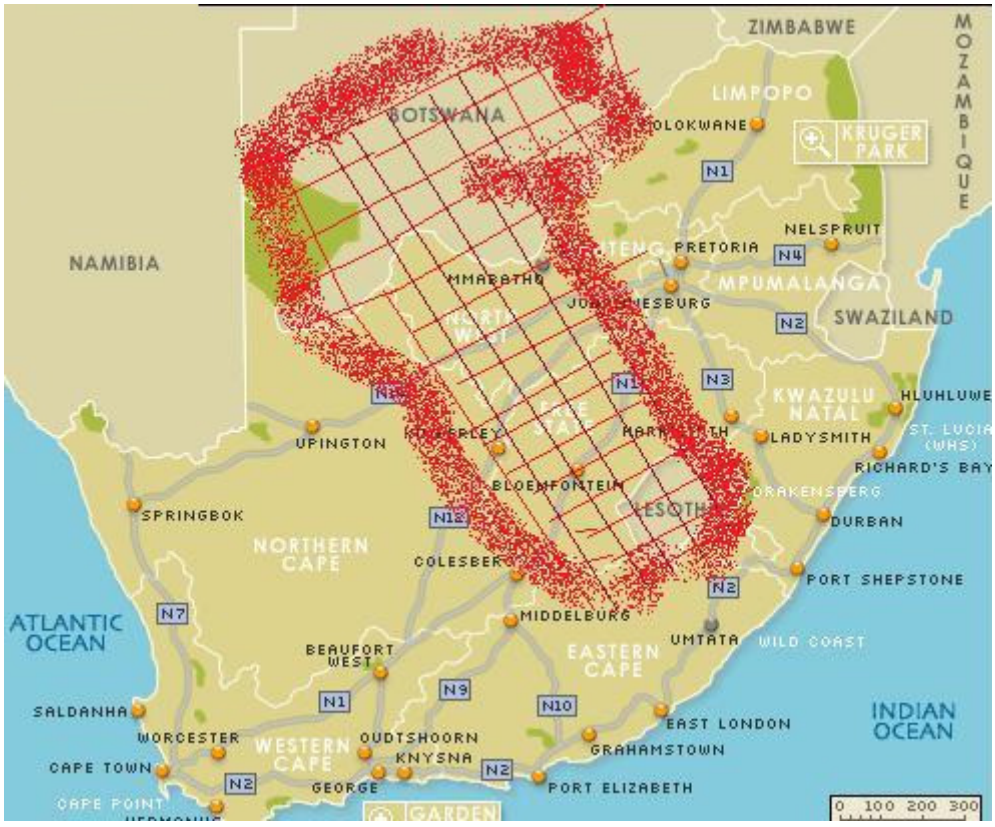

Fig 4-1 : The distribution of the Sotho-Tswana (Tlou & Campbell, 1984)

The highlighted areas indicate the spread of Sotho-Tswana people from Botswana, through South Africa to Lesotho

4.2 MATERIALS

This study was based on the measurement of certain angular and linear parameters relating a series of standard soft tissue lateral facial profile points in adolescent Tswana and non-Tswana subjects.

Materials used in this investigation were the following:

4.2.1 Physical Examination

1. Consent form - Appendix A
2. Examination set - Consists of a mirror and probe
3. Gloves and masks - For infection control
4. Sterilizing solution - For sterilizing instruments
5. Sterilizing basins - Cleaning of instruments
6. Hand soap liquid - For washing hands
7. Kleenex paper towel - For drying hands
8. Desk
9. Chair - Provided by the schools
10. Table

4.2.2 Photography

1. Off-white matt poster - Form background
2. Recording room
3. Sony DSC-P31 Digital Camera - Fig. 4.2
4. Tripod stand
5. Spirit level
6. Battery charger - To charge the camera
7. Electric cord extension
8. Patient labelling disc
9. CorelDRAW 12 programme
10. Computer
11. Printer

4.2.3 **Sample Selection**

Table 4.1 Research Sample Size

	TSWANA	NON-TSWANA	TOTAL
Female	52	25	77
Male	50	25	75
Total	102	50	152

Four different schools were approached to obtain subjects from Mabopane, Soshanguve and Ga-Rankuwa for the study. A total of four hundred and twenty 15-20 year old Tswana and non-Tswana subjects were initially assessed, using no criteria. Hundred and five subjects were obtained from each school.

The following criteria for inclusion in this study were used:

- Complete dentition, third molars disregarded
- Dental Class I occlusion with normal overjet and overbite
- Minimal spacing and crowding
- Balanced facial profile and competent lips
- No history of orthodontic treatment or facial surgery
- Adolescents with no obvious skeletal abnormalities or syndromes
- Normal skeletal relationship

The resultant study sample was 152 subjects which included 102 Tswanas (50 males and 52 females) and 50 non-Tswanas (25 males and 25 females).

4.3 **METHOD**

Firstly a pilot study was conducted on a sample of 5 students selected according to criteria. This was done to calibrate the examiners and the assistant

In the final study two previously calibrated dentists with orthodontic knowledge from the Department of Orthodontics, University of Pretoria and a dental assistant examined and

selected subjects according to criteria. Subjects were given consent forms to take to their guardians or parents. The study was conducted only on those subjects for whom consent was given as prescribed and approved by the ethics committee of the University of Pretoria.

Each subject was asked the questions as set out below:

- Name
- Age
- Ethnic group
- Have you been to an Orthodontist before?
- Are both parents Tswana?

To each subject, the purpose and method of the research was explained and thereafter at their voluntary acceptance of participation, each was asked to sign a release permitting the use of their facial photographs in the study. Further it was verified that they had no objections to the display of their photographs in the course of the study. It was also made clear that the results of the research may be published.

4.3.1 **Photographic Profile**

Standardized lateral photographs were taken with a standardized Sony DSC-P31 digital camera in an appropriate recording room of a school. The subject was positioned in such a way as to get a colour photograph with a sharp profile outline. The subject was instructed to place their teeth in occlusion and to keep the lips relaxed and closed without exerting any undue force looking at a distant mirror. According to Lundström (1982) the normal head posture is defined as the mean position of the head when the individual is standing in a relaxed position with the visual axis horizontal. This may be accomplished by having the subject oriented by looking at an eye reference point i.e. a mirror. The right side of the face was photographed.

Fig. 4.2 : Sony DSC-P31 Digital Camera

4.3.2 **Photographic Profile Procedure**

An orthodontic postgraduate student and a dentist took the photos. A detachable mirror placed 280 mm from the North and West wall was used. The floor was marked 280 mm from the west wall. The profile pictures were taken using a stand with a mounted Sony DSC-P31 digital camera. The photographic set-up (Fig. 4.3) consisted of a Tripod that held the digital camera with a 100mm macro lens and a primary flash. The stability of the elements and the easy adjustment of the Tripod height allowed keeping the optic axis of the lens horizontal during the recording. Levelling devices at the base of the Tripod and on the camera controlled its correct horizontal position. The primary flash was attached to the Tripod by a lateral arm at a distance of 27cm from the Optic axis to avoid the "red-eye effect" on the records. A secondary flash was placed behind the subject to light the background and eliminate undesirable shadows from the contours of the facial profile. The primary and secondary flashes were synchronized.

An off-white matt poster with horizontal and vertical lines forming squares of equal sizes was placed flat on the west wall as backdrop with the lower border 140 mm above the floor.

A sticker with the ID number of the patient, the school name and ethnicity label marked for attachment was positioned to the right of the subject's profile while the subject faced and focused on the mirror. The ID number stickers were marked from 001 to 102 for Tswana subjects and from 103 to 152 for none Tswana subjects. The lens was positioned at a level of the subject's right ear opening whereafter the subject stood in front of the floor marker. The subject faced and focussed on the mirror. When the subject was in the most relaxed position the colour photograph was taken. For each subject a new ID number was placed before taking the photograph. The same procedure and criteria were followed for the non-Tswana subjects.

The records were taken in Natural Head Position (NHP). Each subject was shown where to stand and asked to relax, and then told to walk a few steps, stand at rest facing the camera, and look into their own eyes in the mirror. The lips were also relaxed, adopting their normal position. Eye prescription spectacles were removed and the patient's forehead, neck, and ears were clearly visible during the recording.

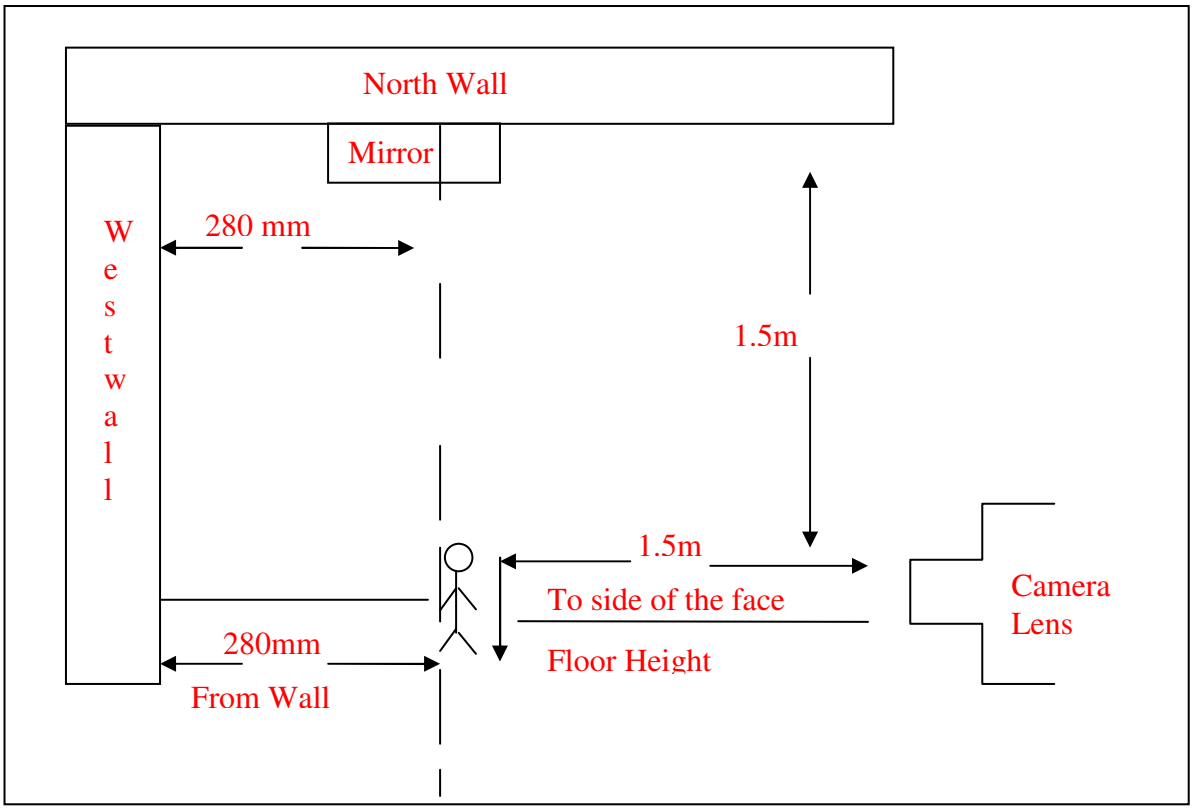

Fig. 4-3: Graphic representation of the photographic set-up

4.3.3 **Computerised Profile Procedure**

Each photograph was then transferred from the Sony memory stick to a personal computer. Photographs were then exported to Adobe Photoshop, oriented and sized to equal sizes. A square with equal sizes was created to ensure that photographs were not squashed or too full. A yellow cross marker was created which was copied and placed on all landmark areas. The programme CorelDRAW 12 was used. Lines, angular and linear measurements were placed on each photo for both Tswana and non-Tswanas. Marks were placed on appropriate landmarks. Landmarks were connected with lines. Linear measurements and angular measurements were done and re-checked for accuracy. There were 14 landmarks, 11 linear measurements and 6 angular measurements. All these were rechecked by a second investigator for accuracy. An Excel spreadsheet was created where all the data was captured. All the measurements were made in the CorelDRAW programme to the nearest accurate clear measurement.

4.3.4 **Statistical Analysis**

Descriptive statistics were calculated from the pooled values for each measurement. The data analysis determined norms for soft tissue facial profiles making use of mean and standard deviation for each linear and angular measurement. For each parameter the differences between the means for the male and female groups and the means between Tswana and non-Tswana ethnic groups were assessed for statistical significance by using a student t-test for independent groups at the $p = < 0,05$ level of significance. The student t-test was used to determine gender differences within the same race and ethnic differences between Tswana and non-Tswana children.

4.3.5 **Reliability of Measurements**

To make landmark determination as consistent as possible, a given landmark was identified on the entire series of photographs for each subject at one sitting. Each was then checked by another investigator. In order to minimize measurement error, one linear measurement (E-LL) and one angular measurement (Gl-Sn-Pog) were performed twice on 30 female Tswana subjects who were randomly selected out of the fifty-two female Tswana's by two

investigators independently of each other. Intra-investigator and inter-investigator measurement errors were predetermined.

4.4 SOFT TISSUE LANDMARKS (Fig. 4.4)

The soft tissue landmarks used in this soft tissue analysis were as follows (Burstone, 1958):

1. Trichion (Tri), the sagittal midpoint of the forehead that borders the hairline.
2. Glabella (Gl), the most anterior point of the middle tine of the forehead.
3. Soft Tissue Nasion (N), the most concave point in the tissue overlying the area of the fronto-nasal suture.
4. Pronasale (Prn), the most prominent point of the tip of the nose
5. Columella Point (Cm), the most anterior point in the columella of the nose (nasal septum).
6. Subnasale (Sn), the point at which the nasal septum merges with the upper cutaneous lip in the mid-saggital plane.
7. Labrale Superius (Ls), a point indicating the mucocutaneous border of the upper lip.
8. Labrale Inferius (Li), a point indicating the mucocutaneous border of the lower lip.
9. Pogonion (Pog), the most anterior point on the soft tissue chin.
10. Soft tissue B (B), the point of greatest concavity in the midline of the lower lip between the labrale inferius and the soft tissue pogonion.
11. Soft tissue Menton (Me), the most inferior point on the soft tissue chin.
12. Soft tissue Gnathion (Gn), the constructed midpoint between soft tissue pogonion and soft tissue menton.
13. Cervical point (C), the inner point between the submental area and the neck located at the intersection of lines drawn tangent to the neck.
14. Stomion (ST), the median point of the oral embrasure when the lips are closed.

Fig. 4-4: Soft Tissue Landmarks

4.4.1 **Linear Measurements** (Fig. 4.5)

1. Holdaway line to Subnasale (mm) (Holdaway, 1983)
2. Holdaway line to lower lip (mm) (Holdaway, 1983)
3. Holdaway line to point B (mm) (Holdaway, 1983)
4. Ricketts line to upper lip (mm) (Ricketts, 1968)
5. Ricketts line to lower lip (mm) (Ricketts, 1968)
6. Steiner line to lower lip (mm) (Steiner, 1953)
7. Steiner line to upper lip (mm) (Steiner, 1953)
8. Soft tissue nasion to soft tissue pogonion to upper lip (mm) (Sushner, 1977)
9. Soft tissue nasion to soft tissue pogonion to lower lip (mm) (Sushner, 1977)
10. Upper lip length (mm) (Sushner, 1977)
11. Lower lip length (mm) (Sushner, 1977)

DEFINITIONS OF LINES AND MEASUREMENTS:

Holdaway line (H-line): A line drawn from the soft tissue chin (pogonion) tangent to the upper lip (Holdaway, 1983).

Ricketts (E-line): A line drawn from the soft tissue chin (pogonion) to the tip of the soft tissue nose was used to describe the mouth to the adjacent structures (nose, cheek and chin) (Ricketts, 1968).

Steiner (S-line): A line drawn from the soft tissue chin to the middle of the lower border of the nose (formed by the lower border of the nose and upper lip). This takes into consideration a large nose or a small nose, and a larger or smaller chin and harmonizes them with the lips (Steiner, 1953).

Nasion-Pogonion line (Na-Pog): A line drawn from soft tissue nasion to soft tissue pogonion (Sushner, 1977).

Upper Lip Length (ULL): The measurement between subnasale and stomion perpendicular to the lower facial plane (Worms *et al*, 1975).

Lower Lip Length (LLL): The measurement between stomion and soft tissue menton perpendicular to the lower facial plane (Worms *et al*, 1975).

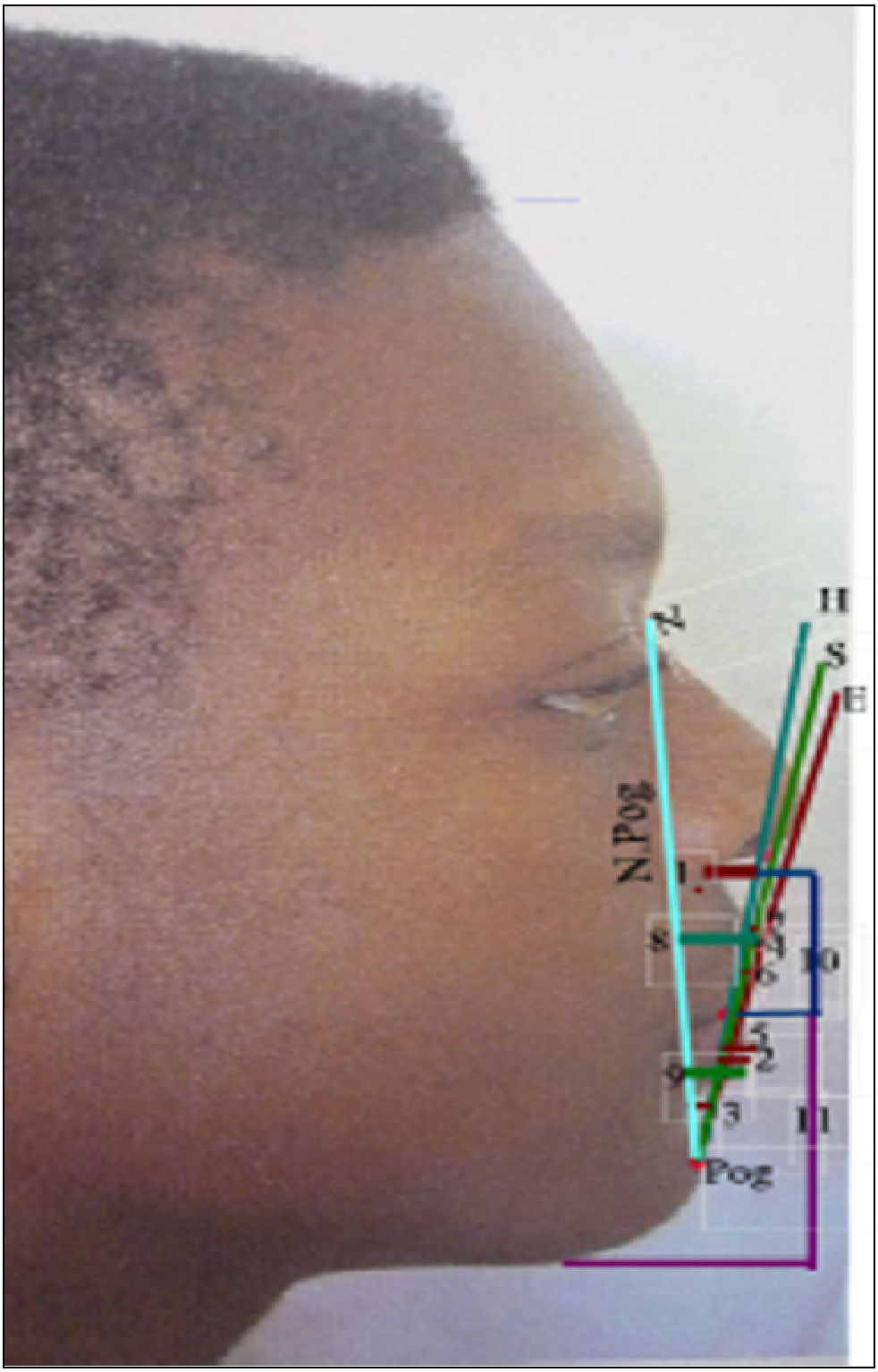

Fig.4-5: Linear Measurements

4.4.2 **Angular Measurements (Fig. 4.6)**

Tri-Gl-Pog	Angle formed by Trichion, Glabella, Soft tissue Pogonion angle (Burstone CJ, 1958)
N-LS-Pog	Angle formed by Soft tissue Nasion, Labiale Superious, Soft tissue Pogonion angle
Cm-Sn-Ls	Angle formed by Collumella, Subnasale, Labiale Superious
Sn-Gn-C	Angle formed by Subnasale, Soft tissue Gnathion, Cervical angle
Gl-Sn-Pog	Angle formed by Glabella, Subnasale, Soft tissue Pogonion angle
Gl-Pr-Pog	Angle formed by Glabella, Pronasale, Soft tissue, Pogonion angle

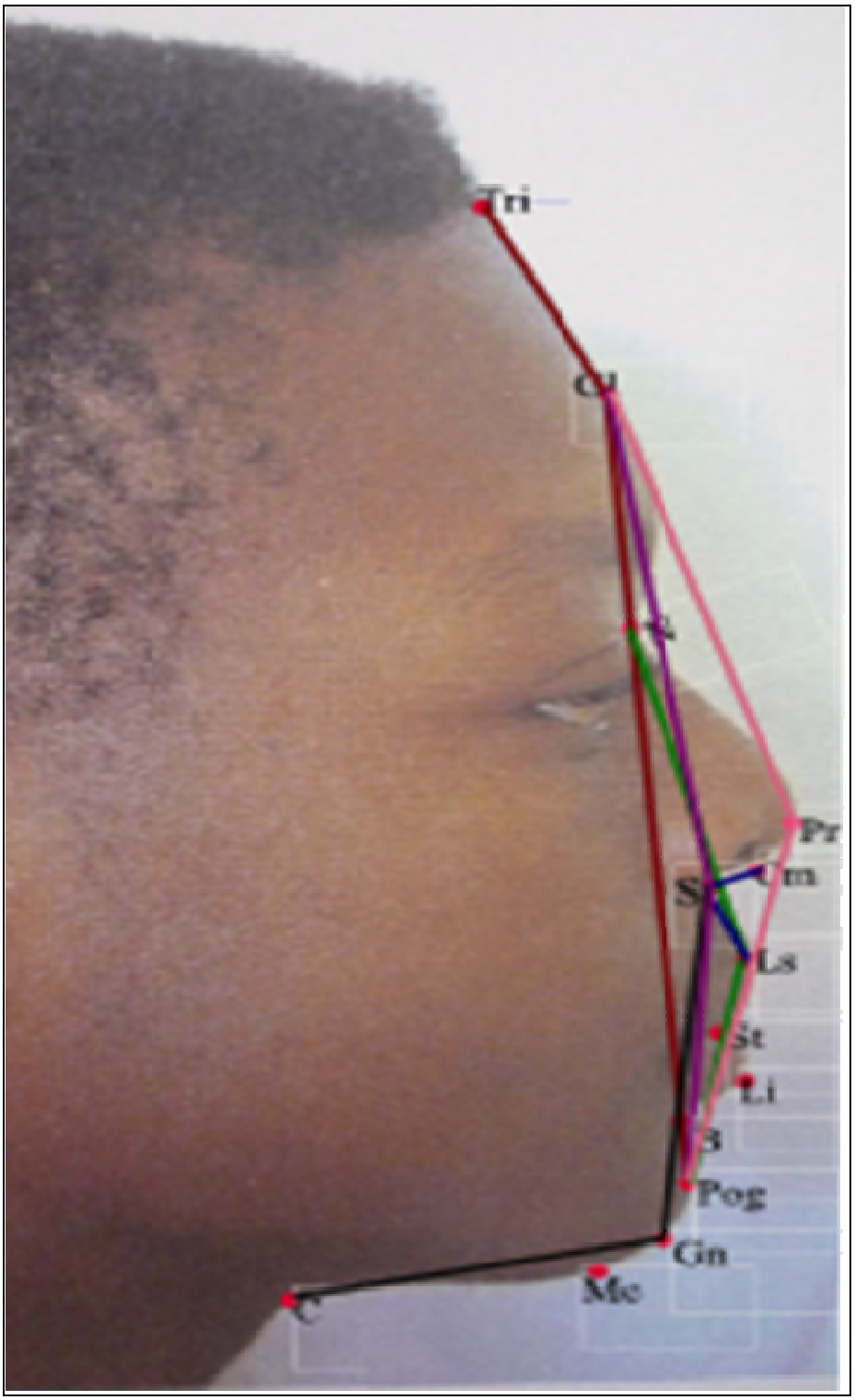

Figure 4-6: Angular Measurements

CHAPTER 5

5.0 RESULTS AND STATISTICS

The means, ranges, standard deviations for all measurements for each group were computed. A student t-test was used to determine differences between groups.

The raw data of this investigation is shown in Annexure A and in various tables. Presentations illustrate a comparison between the Caucasian standards established by Holdaway, Ricketts and Steiner, the Negro standards by Sushner and the Tswana standards established in this study.

Reliability between examiner one and examiner two was determined by a random sample of 30 Tswana females using one angular and one linear measurement i.e. Gl-Sub-Pog and E-LL respectively. Examiner one measured once and observer two measured twice independently. Intra-reliability was at 88% for examiner one and at 90% for examiner two for the E-LL measurement. Intra-reliability was at 87% for examiner one and 99% for examiner two for Gl-Sn-Pog. Therefore the measurements between examiner one and examiner two were very close to each other and therefore reliable at 95% confidence levels. Statistical analysis showed that both the intra and inter-examiner repeatability of placement of landmarks and accuracy of measurement were at acceptable levels.

5.1 The Linear Measurements (in millimetres)

5.1.1 HSn Linear Measurement (Holdaway Line to Subnasale)

Table 5.1.1: ***A comparison of the means and standard deviations of linear measurements (in mm) for Tswana and non-Tswana groups for H to Sn***

NS = Non-significant
S = Significant

PARAMETER	FEMALES			MALES			TOTALS		P-VALUE	
	TSWANA n = 25	NON TSWANA n = 25	TOTAL n = 77	TSWANA n = 50	NON TSWANA n = 25	TOTAL n = 75	TSWANA n = 102	NON TSWANA n = 50	POPULATION GROUP	GENDER
H to Sn										
Mean	-6.545	-6.497	-6.529	-6.663	-6.137	-6.487	-6.603	-6.317	0.2564 NS	0.6315 NS
SD	1.546	1.234	1.444	1.625	1.067	1.477	1.579	1.156		
Min	-9.97	-8.48		-9.96	-7.93					
Max	-3.15	-3.11		-3.09	-3.06					

The mean values for Tswana females and non-Tswana females were -6.545 ± 1.546 mm and -6,497 ± 1.234 mm respectively. The mean values for Tswana and non-Tswana males respectively were -6.663 ± 1.625 mm and – 6.137 ± 1.067 mm. The mean values for the total Tswana and non-Tswana subjects were -6.603 ± 1.579 mm and -6.317 ± 1.156 mm respectively. The analysis of variance (ANOVA) for H-Sn according to gender was p = 0.6315. The analysis of variance for H-Sn according to population group was p = 0.2564. Both values indicating no statistical significant differences.

5.1.2 H-LL Linear Measurement (Holdaway Line to Lower Lip)

Table 5.1.2: ***A comparison of the means and standard deviations of linear measurements (in mm) for Tswana and non-Tswana groups for H to LL***

NS = Non-significant
S = Significant

PARAMETER	FEMALES			MALES			TOTALS		P-VALUE	
	TSWANA n = 25	NON TSWANA n = 25	TOTAL n = 77	TSWANA n = 50	NON TSWANA n = 25	TOTAL n = 75	TSWANA n = 102	NON TSWANA n = 50	POPULATION GROUP	GENDER
H to LL										
Mean	3.492	4.094	3.687	4.515	5.784	4.938	3.993	4.939	0.0163 S*	0.0006 S*
SD	2.094	2.468	2.224	2.140	2.432	2.305	2.168	2.571		
Min	0.01	-2.39		-0.12	1.85					
Max	8.07	8.94		8.89	9.68					

The mean value for female Tswanas and female non-Tswanas were 3.492 ± 2.094 mm and 4.094 ± 2.468 mm respectively. The mean values of male Tswana and male non-Tswanas were 4.515 ± 2.140 and 5.784 ± 2.432 respectively. The mean values for total subjects (Tswanas and non-Tswanas) were 3.993 ± 2.168 mm and 4.939 ± 2.571 mm respectively. The analysis of variance (Anova) according to gender for H-LL was p = 0,0006. The analysis of variance for H-LL according to population group was p = 0,0163.

5.1.3 H-B Linear Measurement (Holdaway Line to Point B)

Table 5.1.3 ***A comparison of the means and standard deviations of linear measurements (in mm) for Tswana and non-Tswana groups for H to B***

NS = Non-significant
S = Significant

PARAMETER	FEMALES			MALES			TOTALS		P-VALUE	
	TSWANA n = 25	NON TSWANA n = 25	TOTAL n = 77	TSWANA n = 50	NON TSWANA n = 25	TOTAL n = 75	TSWANA n = 102	NON TSWANA n = 50	POPULATION GROUP	GENDER
H to B										
Mean	-1.575	-1.553	-1.568	-0.970	-1.000	-0.980	-1.279	-1.271	0.9912 NS	0.0819 NS
SD	1.616	1.350	1.528	2.510	1.416	2.196	2.114	1.398		
Min	-6.55	-3.66		-5.84	-3.09					
Max	3.09	1.88		5.43	2.45					

The mean values for Tswana and non-Tswana females were -1.575 ± 1.616 mm and -1.553 ± 1.350 mm respectively. The mean values for Tswana and non-Tswana males were -0.970 ± 2.510 mm and -1.000 ± 1.416 mm respectively. The mean values for total subjects (Tswana and non-Tswana) were -1.279 ± 2.114 mm and -1.271 ± 1.398 mm respectively. The analysis of variance for H-B according to gender was p = 0,0819. The analysis of variance for H-B according to population group was p = 0,9912.

5.1.4 E-UL Linear Measurement (Ricketts Aesthetic Line to Upper Lip)

Table 5.1.4: ***A comparison of the means and standard deviations of linear measurements (in mm) for Tswana and non-Tswana groups for E to UL***

NS = Non-significant
S = Significant

PARAMETER	FEMALES			MALES			TOTALS		P-VALUE	
	TSWANA n = 25	NON TSWANA n = 25	TOTAL n = 77	TSWANA n = 50	NON TSWANA n = 25	TOTAL n = 75	TSWANA n = 102	NON TSWANA n = 50	POPULATION GROUP	GENDER
E to UL										
Mean	1.917	2.688	2.168	2.486	3.398	2.790	2.196	3.043	0.0312 S*	0.1005 NS
SD	1.891	2.298	2.049	2.436	2.443	2.460	2.183	2.374		
Min	-3.09	-1.53		-2.08	0.01					
Max	5.77	7.42		9.78	7.85					

The mean values for Tswana and non-Tswana females for this value were 1.917 ± 1.891 mm and 2.688 ± 2.298 mm respectively. The mean values for Tswana and non-Tswana males were 2.486 ± 2.436 mm and 3.398 ± 2.443 mm respectively. The mean values for total subjects (Tswana and non Tswanas) were 2.196 ± 2.183 mm and 3.043 ± 2.374 mm respectively. The analysis of variance for E-UL according to gender was p = 0,1005. The analysis of variance for E-UL according to population group was p = 0,0312.

5.1.5 E-LL Linear Measurement (Ricketts Asthetic Line to Lower lip)

Table 5.1.5: ***A comparison of the means and standard deviations of linear measurements (in mm) for Tswana and non-Tswana groups for E to LL***

NS = Non-significant
S = Significant

PARAMETER	FEMALES			MALES			TOTALS		P-VALUE	
	TSWANA n = 25	NON TSWANA n = 25	TOTAL n = 77	TSWANA n = 50	NON TSWANA n = 25	TOTAL n = 75	TSWANA n = 102	NON TSWANA n = 50	POPULATION GROUP	GENDER
E to LL										
Mean	5.044	6.079	5.380	6.755	7.187	6.899	5.883	6.633	0.0998 NS	0.0018 S*
SD	2.203	2.553	2.356	3.036	2.216	2.782	2.768	2.431		
Min	-3.01	.68		-2.54	1.69					
Max	10.14	10.01		13.23	11.22					

The mean values for Tswana and non-Tswana females for this measurement were 5.044 ± 2.203 mm and 6.079 ± 2.553 mm respectively. The mean values for Tswana and non-Tswana males were 6.755 ± 3.036 and 7.187 ± 2.216 mm respectively. The mean values for the total (Tswana and non-Tswana) were 5,883 ± 2.768 mm and 6.663 ± 2.431 mm respectively. The analysis of variance for E-LL according to gender was p = 0,0018. The analysis of variance for E-LL according to population group was p = 0,0998.

5.1.6 S-UL Linear Measurement (Steiner Line to Upper Lip)

Table 5.1.6: ***A comparison of the means and standard deviations of linear measurements (in mm) for Tswana and non-Tswana groups for S to UL***

NS = Non-significant
S = Significant

PARAMETER	FEMALES			MALES			TOTALS		P-VALUE	
	TSWANA n = 25	NON TSWANA n = 25	TOTAL n = 77	TSWANA n = 50	NON TSWANA n = 25	TOTAL n = 75	TSWANA n = 102	NON TSWANA n = 50	POPULATION GROUP	GENDER
S to UL										
Mean	5.297	6.253	5.607	6.412	6.796	6.540	5.843	6.525	0.0975 NS	0.410 NS
SD	2.227	2.469	2.336	2.272	2.509	2.344	2.307	2.479		
Min	1.13	2.8		2.15	3.25					
Max	10.62	11.12		11.74	11.24					

The mean values for female Tswanas and female non-Tswanas were 5.297 ± 2.227 mm and 6.253 ± 2.469 mm respectively. The mean values for Tswana and non-Tswana males were 6.412 ± 2.272 mm and 6.796 ± 2.509 mm respectively. The mean values for total subjects (Tswana and non-Tswana) were 5.843 ± 2.307 mm and 6.525 ± 2.479 mm respectively. The analysis of variance for S-UL according to gender was p = 0,410. The analysis of variance for S-UL according to population group was p = 0,0975.

5.1.7 S-LL Linear Measurement (Steiner Line to Lower Lip)

Table 5.1.7: ***A comparison of the means and standard deviations of linear measurements (in mm) for Tswana and non-Tswana groups for S to LL***

NS = Non-significant
S = Significant

PARAMETER	FEMALES			MALES			TOTALS		P-VALUE	
	TSWANA n = 25	NON TSWANA n = 25	TOTAL n = 77	TSWANA n = 50	NON TSWANA n = 25	TOTAL n = 75	TSWANA n = 102	NON TSWANA n = 50	POPULATION GROUP	GENDER
S to LL										
Mean	6.750	7.566	7.015	8.626	8.616	8.623	7.669	8.091	0.3338 NS	0.0006 S*
SD	2.027	2.749	2.300	2.570	2.456	2.516	2.483	2.634		
Min	1.5	2.8		3.09	2.31					
Max	11.41	11.12		15.08	12.6					

The mean values for Tswana and non-Tswana females were 6.750 ± 2.027 and 7.566 ± 2.749 mm respectively. The mean values for Tswana and non-Tswana males were 8.626 ± 2.570 and 8.616 ± 2.456 respectively. The mean values for total subjects (Tswana and non-Tswana) were 7.669 ± 2.483 and 8.091 ± 2.634 respectively. The analysis of variance for S-LL according to gender was p = 0,0006. The analysis of variance for S-LL according to population group was p = 0,3338.

5.1.8 N-Pog-UL Linear Measurement (Nasion Pogonion to Upper Lip)

Table 5.1.8: ***A comparison of the means and standard deviations of linear measurements (in mm) for Tswana and non-Tswana groups for Na-Pog to UL***

NS = Non-significant
S = Significant

PARAMETER	FEMALES			MALES			TOTALS		P-VALUE	
	TSWANA n = 25	NON TSWANA n = 25	TOTAL n = 77	TSWANA n = 50	NON TSWANA n = 25	TOTAL n = 75	TSWANA n = 102	NON TSWANA n = 50	POPULATION GROUP	GENDER
Na-Pog-UL										
Mean	13.216	14.891	13.76	17.479	17.440	17.466	15.306	16.166	0.1983 NS	0.0000 S*
SD	3.566	3.591	3.637	4.158	2.782	3.736	4.404	3.430		
Min	3.2	8.79		5.7	10.7					
Max	24.03	20.61		26.8	22.43					

The mean values for Tswana and non-Tswana females were 13.216 ± 3.566 mm and 14.891 ± 3.591 mm respectively. The mean value for Tswana and non-Tswana males were 17.479 ± 4.158 mm and 17.440 ± 2.782 mm respectively. The mean values for total subjects (Tswana and non-Tswana) were 15.306 ± 4.404 mm and 16.166 ± 3.430 mm respectively. The analysis of variance for Na-Pog-UL according to gender was p = 0,0000. The analysis of variance for Na-Pog-UL according to population group was p = 0,1983.

5.1.9 N-Pog-LL Linear Measurement (Nasion Pogonion to Lower Lip)

Table 5.1.9: ***A comparison of the means and standard deviations of linear measurements (in mm) for Tswana and non-Tswana groups for Na-Pog to LL***

NS = Non-significant
S = Significant

PARAMETER	FEMALES			MALES			TOTALS		P-VALUE	
	TSWANA n = 25	NON TSWANA n = 25	TOTAL n = 77	TSWANA n = 50	NON TSWANA n = 25	TOTAL n = 75	TSWANA n = 102	NON TSWANA n = 50	POPULATION GROUP	GENDER
Na-Pog-LL										
Mean	10.955	11.966	11.283	13.909	13.076	13.631	12.403	12.521	0.8633 NS	0.0001 S*
SD	2.720	3.177	2.895	3.453	2.277	3.120	3.424	2.793		
Min	5.06	5.48		6.42	8.25					
Max	21.46	18.31		22.15	17.12					

Mean values for Tswana and non-Tswana females were 10.995 ± 2.720 mm and 11.966 ± 3.177 mm respectively. The mean values for Tswana and non-Tswana males were 13.909 ± 3.453 mm and 13.076 ± 2.277 mm respectively. The mean values for total subjects (Tswana and non Tswana) were 12.403 ± 3.424 mm and 12.521 ± 2.793 mm respectively. The analysis of variance for Na-Pog-LL according to gender was p = 0,0001. The analysis of variance for Na-Pog-LL according to population group was p = 0,8633.

5.1.10. LLL Linear Measurement (Lower Lip Length)

Table 5.1.10: ***A comparison of the means and standard deviations of linear measurements (in mm) for Tswana and non-Tswana groups for LLL***

NS = Non-significant
S = Significant

PARAMETER	FEMALES			MALES			TOTALS		P-VALUE	
	TSWANA n = 25	NON TSWANA n = 25	TOTAL n = 77	TSWANA n = 50	NON TSWANA n = 25	TOTAL n = 75	TSWANA n = 102	NON TSWANA n = 50	POPULATION GROUP	GENDER
LLL										
Mean	56.612	55.758	56.335	62.634	55.588	60.286	59.564	55.673	0.0029 S*	0.0263 S*
SD	5.734	4.364	5.314	10.028	7.579	9.818	8.634	6.121		
Min	42.47	50		25.72	24.99					
Max	72.58	68.82		81.05	67.12					

The mean values for Tswana and non-Tswana females were 56.612 ± 5.734 mm and 55.758 ± 4.364 mm respectively. The mean values for Tswana and non-Tswana males were 62.634 ± 10.028 mm and 55.588 ± 7.579 mm respectively. The mean values for total subjects (Tswana and non-Tswana) were 59.564 ± 8.634 mm and 55.673 ± 6.121 mm respectively. The analysis of variance for LLL according to gender was p = 0,0263. There were statistically significant differences among gender for this value. The analysis of variance for LLL according to population group was p = 0,0029.

5.1.11 ULL Linear Measurement (Upper Lip Length)

Table 5.1.11: ***A comparison of the means and standard deviations of linear measurements (in mm) for Tswana and non-Tswana groups for ULL***

NS = Non-significant
S = Significant

PARAMETER	FEMALES			MALES			TOTALS		P-VALUE	
	TSWANA n = 25	NON TSWANA n = 25	TOTAL n = 77	TSWANA n = 50	NON TSWANA n = 25	TOTAL n = 75	TSWANA n = 102	NON TSWANA n = 50	POPULATION GROUP	GENDER
ULL										
Mean	26.705	27.307	26.9	30.759	29.560	30.359	28.692	28.434	0.6751 NS	0.0000 S*
SD	3.269	2.416	3.016	4.751	5.461	4.995	4.527	4.332		
Min	18.59	22.52		21.27	23.25					
Max	34.78	32.43		52.97	52.71					

The mean values for Tswana and non-Tswana females were 26.705 ± 3.269 mm and 27.307 ± 2.416 mm respectively. The mean values for Tswana and non-Tswana males were 30.759 ± 4.751 mm and 29.560 ± 5.461 mm respectively. The mean value total subjects (Tswana and non-Tswana) were 28.692 ± 4.527 and 28.434 ± 4.332 mm respectively. The analysis of variance for ULL according to gender was p = 0,0000. The analysis of variance for ULL according to population group was p = 0.6751.

5.2 The Angular Measurements (in degrees)

5.2.1 Cm-Sn-Ls Angular Measurement (Collumela-Subnasale-Labriale Superious)

Table 5.2.1: ***A comparison of the means and standard deviations of angular measurements (in degrees) for Tswana and non-Tswana groups for Cm to Sub to LS***

NS = Non-significant
S = Significant

PARAMETER	FEMALES			MALES			TOTALS		P-VALUE	
	TSWANA n = 52	NON TSWANA n = 25	TOTAL n = 77	TSWANA n = 50	NON TSWANA n = 25	TOTAL n = 75	TSWANA n = 102	OTHER n = 50	POPULATION GROUP	GENDER
Cm-Sub-LS										
Mean	92.387	89.784	91.542	86.341	87.041	86.574	89.423	88.412	0.6661 NS	0.0477 S*
SD	12.868	17.029	14.290	10.683	11.279	10.814	12.174	14.362		
Min	56.6	60.51		64.33	64.23					
Max	126.16	125.41		110.13	102.62					

The mean values for Tswana and non-Tswana females were 92.387 ± 12.868 and 89.784 ± 17.029 degrees respectively. The mean values for male Tswana and non-Tswana males were 86.341 ± 10.683 degrees and 87.041 ± 11.279 degrees respectively. The mean values for total subjects (Tswana and non-Tswana) were 89.423 ± 12.174 degrees and 88.412 ± 14.362 degrees. The analysis of variance for Cm-Sub-Ls according to gender was p = 0,047. The analysis of variance for Cm-Sub-Ls according to population groups was p = 0,666.

5.2.2 Gl-Sn-Pog Angular Measurement (Glabella-Subnasale-Pogonion)

Table 5.2.2: ***A comparison of the means and standard deviations of angular measurements (in degrees) for Tswana and non-Tswana groups for Gl to Sn to Pog***

NS = Non-significant
S = Significant

PARAMETER	FEMALES			MALES			TOTALS		P-VALUE	
	TSWANA n = 52	NON TSWANA n = 25	TOTAL n = 77	TSWANA n = 50	NON TSWANA n = 25	TOTAL n = 75	TSWANA n = 102	OTHER n = 50	POPULATION GROUP	GENDER
Gl-Sub-Pog										
Mean	171.270	170.100	170.890	168.31	168.405	168.342	169.819	169.253	0.5504 NS	0.0104 S*
SD	4.831	6.207	5.304	4.993	5.242	5.042	5.108	5.750		
Min	160.45	156.81		153.01	156.2					
Max	180	177.93		178.6	179.06					

The mean values for Tswana and non-Tswana females were 171.270 ± 4.831 degrees and 170.100 ± 6.207 degrees respectively. The mean values for Tswana and non-Tswana males were 168.31 ± 4.993 degrees and 168.405 ± 5.242 degrees respectively. The mean values for total subjects (Tswana and non-Tswana) were 169.819 ± 5.108 degrees and 169.253 ± 5.750 degrees respectively. The analysis of variance for Gl-Sub-Pog according to gender was p = 0,0104. The analysis of variance to Gl-Sub-Pog according to population group was p = 0,5504.

5.2.3 Gl-Pr-Pog Angular Measurement (Glabella-Pronasale-Pogonion)

Table 5.2.3: ***A comparison of the means and standard deviations of angular measurements (in degrees) for Tswana and non-Tswana groups for Gl to Pr to Pog***

NS = Non-significant
S = Significant

PARAMETER	FEMALES			MALES			TOTALS		P-VALUE	
	TSWANA n = 52	NON TSWANA n = 25	TOTAL n = 77	TSWANA n = 50	NON TSWANA n = 25	TOTAL n = 75	TSWANA n = 102	OTHER n = 50	POPULATION GROUP	GENDER
Gl-Pr-Pog										
Mean	152.897	153.314	153.032	148.595	148.654	148.615	150.788	150.984	0.8010 NS	0.0000 S*
SD	6.376	5.697	6.129	4.157	5.460	4.595	5.795	6.003		
Min	138.34	138.75		137.45	134.3					
Max	173.67	162.66		156.62	160.53					

The mean values for Tswana and non-Tswana females were 152.897 ± 6.376 degrees and 153.314 ± 5.697 degrees respectively. The mean values for Tswana and non-Tswana males were 148.595 ± 4.157 degrees and 148.654 ± 5.460 degrees respectively. The mean values for total subjects (Tswana and non-Tswana) were 150.788 ± 5.795 degrees and 150.984 ± 6.003 degrees respectively. The analysis of variance for Gl-Pr-Pog according to gender was p = 0,0000. The analysis of variance for Gl-Pr-Pog according to population group was p = 0,8010.

5.2.4 N-LS-Pog (Nasion-Labriale Superius Pogonion)

Table 5.2.4: ***A comparison of the means and standard deviations of angular measurements (in degrees) for Tswana and non-Tswana groups for N to LS to Pog***

NS = Non-significant
S = Significant

PARAMETER	FEMALES			MALES			TOTALS		P-VALUE	
	TSWANA n = 52	NON TSWANA n = 25	TOTAL n = 77	TSWANA n = 50	NON TSWANA n = 25	TOTAL n = 75	TSWANA n = 102	OTHER n = 50	POPULATION GROUP	GENDER
N-LS-Pog										
Mean	153.477	151.679	152.894	150.010	146.901	148.973	151.778	149.290	0.0001 S*	0.02065 S*
SD	6.223	6.221	6.239	6.458	4.598	6.054	6.544	5.928		
Min	142.78	140.73		135.70	138.16					
Max	166.49	163.2		166.19	157.78					

The mean values for Tswana and non-Tswana females were 153.477 ± 6.223 and 151.679 ± 6.221 respectively. The mean values for Tswana and non-Tswana males were 150.010 ± 6.458 degrees and 146.901 ± 4.598 degrees respectively. The mean values for the total subjects (Tswana and non-Tswana) were 151.778 ± 6.544 degrees and 149.290 ± 5.928 degrees respectively. The analysis of variance for N-LS-Pog according to gender was p = 0,02065. The analysis of variance for N-LS-Pog according to population group was p = 0,0001.

5.2.5 Sn-Gn-Cerv (Subnasale-Gnathion-Cervical)

Table 5.2.5: ***A comparison of the means and standard deviations of angular measurements (in degrees) for Tswana and non-Tswana groups for Sub to Gn to Cerv***

NS = Non-significant
S = Significant

PARAMETER	FEMALES			MALES			TOTALS		P-VALUE	
	TSWANA n = 52	NON TSWANA n = 25	TOTAL n = 77	TSWANA n = 50	NON TSWANA n = 25	TOTAL n = 75	TSWANA n = 102	OTHER n = 50	POPULATION GROUP	GENDER
Sub-Gn-Cerv										
Mean	103.683	103.279	103.552	106.428	104.844	105.900	105.029	104.061	0.3493 NS	0.0437 S*
SD	5.807	6.621	6.042	6.151	6.273	6.195	6.106	6.432		
Min	92.92	90.98		92.31	88.04					
Max	116.12	119		122.53	114.25					

The mean values for Tswana and non-Tswana females were 103.683 ± 5.807 degrees and 103.279 ± 6.621 degrees respectively. The mean values for Tswana and non-Tswana males were 106.428 ± 6.042 degrees and 104.844 ± 6.273 degrees respectively. The mean values for total subjects (Tswana and non-Tswana) were 105.029 ± 6.106 degrees and 104.061 ± 6.432 degrees respectively. The analysis of variance for Sub-Gn-Cerv according to gender was p = 0,437. The analysis of variance for Sub-Gn-Cerv according to population group was p = 0,3493.

5.2.6 Tri-Gl-Pog Angular Measurement (Trichion-Glabella-Pogonion Angle)

Table 5.2.6: ***A comparison of the means and standard deviations of angular measurements (in degrees) for Tswana and non-Tswana groups for Tri to Gl to Pog***

NS = Non-significant
S = Significant

PARAMETER	FEMALES			MALES			TOTALS		P-VALUE	
	TSWANA n = 52	NON TSWANA n = 25	TOTAL n = 77	TSWANA n = 50	NON TSWANA n = 25	TOTAL n = 75	TSWANA n = 102	OTHER n = 50	POPULATION GROUP	GENDER342
Tri-Gl-Pog										
Mean	160.018	158.407	159.495	159.515	158.240	159.090	159.771	158.32	0.1372 NS	0.7289 NS
SD	5.946	5.458	5.806	5.376	5.377	5.374	5.651	5.363		
Min	147.17	145.72		151.33	147.37					
Max	176.88	169.8		172.97	168.11					

The mean values for Tswana and non-Tswana females were 160.018 ± 5.946 degrees and 158.407 ± 5.458 degrees respectively. The mean values for Tswana and non-Tswana males were 159.515 ± 5.376 degrees and 158.240 ± 5.377 degrees respectively. The mean values for total subjects (Tswana and non-Tswana) were 159.771 ± 5.651 degrees and 158.320 ± 5.363 degrees respectively. The analysis of variance for Tri-Gl-Pog according to gender was p = 0,7289. The analysis of variance for Tri-Gl-Pog according to population subjects was p = 0,1372.

CHAPTER 6

6.0 DISCUSSION

This study has determined the angular and linear soft tissue measurements of a sample of young adolescent Tswana and non-Tswana subjects. Eleven linear measurements and six angular measurements that describe various aspects of the soft tissue profile were evaluated and compared to other existing values of Caucasians and Negroids.

Judgement of facial aesthetics is subjective and is undoubtedly dependent on various cultural, social, geographic and psychological backgrounds of people. Orthodontists should consider these variables during treatment planning. Traditionally Orthodontists have used lines and angles for evaluation of the soft tissue profile derived from Caucasian samples and very little information has been available for other races. The data gathered in this study indicates differences in measured parameters when compared to similar studies done on Caucasians (Legan and Burstone, 1980), Negroids (Sushner, 1977), and other African blacks (Naidoo and Miles, 1977 and Flynn *et al.*, 1989).

The faces of the black sample group used in this study were shown to be more protrusive when compared to their white counterparts, confirmed by the studies of Ricketts (1961); Steiner (1953) and Holdaway (1983). (The landmark points measured on the profile were further anterior to the white standards).

Sushner (1977) studied the soft tissue profile of Negroid groups and found that males are considerably more protrusive than females. Although the analyses of Ricketts (1961), Steiner (1953), and Holdaway (1983) are valid and certainly contribute toward beneficial and successful treatment of patients, studies of the black profile have indicated that these standards are different enough to warrant close evaluation (Sushner, 1977).

Previous studies evaluating African American profiles showed a preference for straighter or more Caucasian features. Martin (1964) used subjective responses to photographs taken from magazines as his data. Thomas (1980) evaluated profile tracings taken from photographs of American African females and Sushner (1977) obtained measurements directly from

photographs of actual profiles. Sushner (1977) obtained measurements directly from photographs of African-Americans. All these studies concluded that African-Americans prefer a straighter but not necessarily Caucasian profile.

Olsen *et al.,* (1996) compared aesthetic evaluations of Caucasian and African American profiles by professionals and lay people. They found that a more retruded African American profile was preferred over a more protrusive profile. This current study is contrary to the findings of the literature cited above regarding African Americans. However it supports the study by Beukes *et al.,* (2006) on African Blacks where it was found that a fuller profile was preferable to a straight flat profile.

6.1 H-Sn linear measurement (Holdaway line to subnasale)

H-Sn measurement of non-Tswana (-6.497mm) and Tswana females (-6.545 mm) had almost similar values. In African Americans, Sushner (1977), this measurement was found to be smaller (-6.2 mm) when compared with Tswana and non-Tswana females. In non-Tswana males the H-Sn measurement was slightly higher (-6.137) compared to Tswana males (-6.63 mm). These results can be correlated with those results of Sushner (1977) where this measurement was found to be larger (-7.8 mm).

6.2 H-LL Linear Measurement (Holdaway line to lower lip)

H-LL measurement for non-Tswana females (4.094 mm) and for Tswana females (3,492 mm) indicated that the non-Tswana females group had slightly more protrusive lower lips than their Tswana female counterpart. H-LL measurement for Tswana males (4,515mm) was smaller compared to non-Tswana males (5.784mm). There was a statistically significant difference in these values. The non-Tswana male group had slightly more protrusive lower lips than their Tswana male counterpart. Negroids were found to have a retrusive lower lip compared Tswana and non-Tswana females. Caucasian males were less protrusive when compared to Tswana and non-Tswana males (Holdaway, 1983). Black American males (Sushner, 1977) were more retrusive than Tswana and non-Tswana males. The gender and the ethnic group in this study showed statistically significant difference.

6.3 H-B Linear Measurement (Holdaway line to point B)

H-B measurement for Tswana male (0.980) and female (1,553) and non-Tswana male (-1,000) and female (-1.553) were almost similar. This value indicated a deeper labio-mental fold for both groups. Sushner (1977) found that the labio-mental fold was much deeper than in both Tswana and non-Tswana's by -2.8 mm in female Negroids and -3.00 mm in male Negroids.

6.4 Ricketts line to upper lip Linear Measurements (E-UL)

Non-Tswana females showed more protrusive upper lips than Tswana females. Compared to Sushner's (1997) study on Negroid males (+0.33 mm) and female (-0.47 mm), non-Tswana and Tswanas were more protrusive at values of (3.398 mm) and (2.486 mm) for males and (2.688) and (1.917 mm) for females respectively. Caucasians (-4.0 mm) have very retrusive lips compared to Tswanas and non-Tswanas. Sushner (1977) also found Negroid subjects to be more protrusive than Caucasian subjects. There were no statistically significant differences for the E-line, however statistically significant difference was seen between Tswana and non-Tswanas.

6.5 Ricketts line to lower lip Linear Measurement (E-LL)

The E-LL measurement for non-Tswana females (6.079 mm) and males (7.187 mm) were found to be higher than that of Tswana males (6.756 mm) and Females (5.044 mm). This indicated that lower lip in non-Tswana is more anteriorly positioned compared to the Tswana group. In Caucasians (-2.0 mm) (Ricketts, 1968), the lower lip to E-line is very retrusive compared to both Tswana and non-Tswana groups. Lower lip to E-line is less protrusive compared to both non-Tswana and Tswana subjects for Negroids (Sushner, 1977) (-0.47 mm for females and 0.33 mm for males). A statistically significant difference was found between males and females, but no statistically significant difference was seen among the ethnic groups. Bacon *et al.,* (1983) found a range of -1 to +10 mm for lower lip to E-line in Negroid population. In regard to the these measurement their results show similar range between the Tswana females -3 to 10mm and non-Tswana females 0.68 to 10,01 mm. The measurements for Tswanas were slightly less than that of the non-Tswanas. However the values between males and females in Bacon *et al.,* (1983) were not statistically significant.

The findings of this study indicates that Tswana and non-Tswanas have fuller, more procumbent lips than Caucasians (Ricketts, 1968), Steiner (1953) and Holdaway (1983) and in Negroids (Sushner, 1977 and Bacon *et al.*, 1983)

6.6 Steiner line to upper lip (S-UL)

S-line to upper lip measurement was higher for non-Tswana males (6.796 mm) and females (6.253 mm) compared to Tswana males (6.412 mm) and females (5.297 mm). When looking at groups non-Tswanas were more protrusive compared to Tswanas. Caucasians (Steiner, 1953) (-2.87 mm) were less protrusive compared to non-Tswanas and Tswanas. The Negroid upper lips were less protrusive (Sushner, 1977) (5.5 mm) than Tswanas and non Tswanas. No statistical significant between population and gender for all subjects for S-line to upper lip.

6.7 Steiner line to lower lip (S-LL)

S-line to lower lip measurement was slightly higher for non-Tswana males (8.616 mm) and females Tswanas (7.566 mm) compared to Tswana males (8.626 mm) and females (6.750 mm). Therefore non-Tswana males and females were more protrusive for the lower lip than Tswana males and females. The Negroid males (Sushner, 1977) with a value of 5.0 mm and females with a value of 3.9 mm were less protrusive compared to Tswana and non-Tswanas. The Caucasians (Steiner, 1953) with a value of -2.02 mm were less protrusive when compared to Tswana and non-Tswanas. There was a statistical significant difference between genders. No statistical significant difference was seen between groups.

6.8 Nasion Pogonion to upper lip (N-Pog-UL)

The N-Pog-UL measurement was higher in non-Tswana females (14.891 mm) compared to Tswana females (13.216 mm). The Na-Pog-UL was high in Tswana males (17.440 mm) than in non-Tswana males (17.440 mm). There were statistical significant differences between genders for Na-Pog-UL. Males were more protrusive than females in both groups for this value. There were no statistical significant differences between groups. The Negroid subjects (Sushner, 1977) were less protrusive with a value of 10.3 mm for males and 8.8 mm for females. No report could be found on Caucasians for this value.

6.9 Nasion-Pogonion to lower lip (N-Pog-LL)

The measurement of lower lip to Nasion-Pogonion line was higher in non-Tswana females (11,966 mm) than in Tswana females (10.955 m). The measurement of lower lip to Nasion-Pogonion line was higher in Tswana males (13.909 mm) than in non-Tswana males (13.076 mm). There was a statistical significant difference between genders for Na-Pog-LL. Males were more protrusive than females in both groups. There were no statistical significant differences between ethnic groups. The Negroid group (Sushner, 1977) was less protrusive compared to Tswana and non-Tswana subjects for Nasion-Pogonion to lower lip whose measurement value is 7.8 mm for males and 6.7 mm for females. No report could be found on Caucasians for this value.

6.10 Upper Lip Length (ULL)

Non-Tswana females (27.307 mm) have a longer upper lip length compared to Tswana females (26.705 mm). Tswana males (30.759 mm) have a longer upper lip length compared to non-Tswana males (29.5600 mm). There were no statistically significant differences between ethnic groups, however comparison between gender indicated a statistical significant difference in males. The Negroid's upper lip length was shorter than that of Tswanas and non-Tswanas by 17.9 mm for males and 14.5 mm for females (Sushner, 1977). Caucasians have shorter ULL compared to Tswanas and non-Tswanas (Ricketts, 1961).

6.11 Lower Lip Length (LLL)

Tswana females have a slightly longer lower lip length value (56.612 mm) than non-Tswana females (55.758 mm). Tswana males have a significantly longer lower lip value (62.634 mm) than the non-Tswana male's value (55.585 mm). There was a statistically significant difference between male and female Tswanas as well as between Tswana and non-Tswana subjects for the lower lip length. The lower lip length for Negroids (Sushner, 1977) was shorter than that of Tswanas and non-Tswanas, the value being 26,1 mm for male and 24,34 for females. Caucasians (Ricketts, 1961) had a shorter lower lip length compared to Tswana and non-Tswana subjects and this is in agreement with the data from Connor and Moshiri, (1985).

6.12 N-LS-Pog Angle (Nasion-Labriale Superius-Pogonion)

The N-LS-Pog angle was smaller in non-Tswana females (153.477 degrees) when compared with Tswana females (151.679 degrees). The N-LS-Pog angle was smaller in Tswana males (150,010 degrees) in non-Tswana males (146.598 degrees). No statistical significant difference was found between genders as well as ethnic groups for N-LS-Pog. No comparative value was found for this value for Caucasians and Negroids.

6.13 Cm-Sn-LS Angle (Nasiolabial angle)

The Nasiolabial angle was larger and obtuse in Tswana females (92.387 degrees) compared to non-Tswana females (89.784 degrees). Tswana males had a greater nasiolabial angle (89,423 degrees) than non-Tswana males (88.412 degrees). Tswana females had a greater nasiolabial angle (92,387 degrees) than their male Tswana counterparts (86,341 degrees). However, the difference for the nasiolabial angle between gender and groups were not statistically significant. Tswana and non-Tswanas nasiolabial angle was larger than that of South African black females reported by Naidoo and Miles (1997) (Table. 6.2) and Flynn *et al.,* (1989) for the African Americans (Table 6.1) but smaller than that of the Caucasian study conducted by Legan and Burstone (1980) (Table. 6.3).

6.14 Sn-Gn-Cerv Angle (Subnasale-Gnathion-Cervical angle) (Lower Throat Angle)

Tswana females had a slightly greater lower face throat angle (103.683 degrees) than non-Tswana females (103.279 degrees). Tswana males (106.428 degrees) had a larger lower face throat angle (104.844 degrees). Tswanas (105.029 degrees) had a slightly larger lower face throat angle than non-Tswanas (104.844 degrees). A statistically significant difference was found for lower facial angle in both males and females. The male angle showed statistically significant difference compared to females in both groups. Compared to Caucasians Legan and Burstone (1980) (Table 6.3), Tswanas and non-Tswanas had a larger lower face throat angle. Compared to African American females, Flynn *et al.,* (1989) (Table 6.2) the lower face throat angle was larger for both Tswana and non-Tswana females. Compared to African American males, Flynn *et al.,* (1989) (Table 6.2) the lower face throat angle was larger than that of Tswana and non-Tswana males. Tswana and non-Tswanas generally had a larger lower face throat angle compared to the South African black studied by Naidoo *et al.,* (1997) (Table 6.1).

6.15 Gl-Sn-Pog Angle (Glabella-Subnasale-Pogonion)

Tswana males (168,31 degrees) and females (171.270 degrees) were slightly more convex compared to non-Tswana males (168.405 degrees) and females (168.31 degrees). The total Tswana group (168.819 degrees) were slightly more convex than the non-Tswanas (170,890 degrees). Statiscally significant difference was found between genders. Females were generally more convex than males. However there was no statistically significant difference between the ethnic groups. Non-Tswana and Tswana males were more convex compared to African American males (Flynn *et al.,* 1989) (Table 6.2). Caucasians are flatter when compared to the more convex profile of Tswana and non-Tswanas (Legan and Burstone (1980) (Table 6.3). This is in agreement with previous studies (Bacon *et al.,* 1983 and Sushner, 1977) which found that Negroids have a fuller profile compared to a flatter profile of Caucasians.

6.16 Gl-Pr-Pog Angle (Facial Convexity Angle) (Glabella-Pronasale-Pogonion)

Non-Tswana females had a slightly sharper nasal tip (153,314 degrees) and therefore a larger facial convexity angle compared to Tswana females (152.897 degrees). The Tswana (148,595 degrees) and non-Tswana (148.654 degrees) males had almost similar facial convexity angle. Non-Tswana females had a larger facial convexity angle (153.314 degrees) than their male counterparts (148.615 degrees). Tswanas had less prominent noses compared to non-Tswanas. However, the difference between Tswanas and non-Tswanas was statistically insignificant.

6.17 Tri-Gl-Pog Angle (Total Facial Convexity Angle) (Trichion-Glabella-Pogonion)

Tswana males (159.515 degrees) and females (160.018 degrees) have a larger angle for Tri-Gl-Pog than non-Tswana females (158.407 degrees) and males (158.240 degrees). The total Tswana group has a larger total facial convexity angle than the total non-Tswana group for this value. However there were statistically insignificant differences between ethnic groups. No comparative studies were found on this value.

***Table 6.1*: A comparison of the means and standard deviation of angular measurement values of black South African females (Naidoo & Miles, 1977), the African American females (Flynn *et al.*, 1989) and the current Tswana and non-Tswana females**

		Previous studies		Current study	
Measurement in degrees	**Landmarks**	**Flynn *et al.*, (N = 15) African American**	**Naidoo and Miles (N = 15) Black South African**	**Tswana N = 52**	**Non-Tswana N = 25**
Facial convexity angle	Gl-Sn-Pog	120.0º ± 5.4	107.0º ± 4.4	171.270 ± 4.993	170.10 ± 5.242
Lower face throat angle	Sn-Gn-C	99.4º ± 12.2	92.5º ± 8.6	103.68 ± 5.807	103.279 ± 6.621
Naso labial angle	Cm-Sn-Ls	87.7º ± 12.8	84.4º ± 13.2	92.387 ± 12.868	89.784 ± 6.221

***Table 6.2*: A comparison of the means and standard deviations of angular measurement values of black South African males and African American males (Flynn *et al.*, 1989; Naidoo & Miles, 1977) and the current Tswana and non-Tswana males**

		Previous studies		Current study	
Measurement in degrees	**Landmarks**	**Flynn *et al.*, (N = 15) African Americans**	**Naidoo and Miles (N = 15) Black South African**	**Tswana N = 52**	**Non-Tswana N = 25**
Facial convexity angle	Gl-Sn-Pog	130.3º ± 6.7	107º ± 5.3	168.31 ± 4.993	168.405 ± 5.242
Lower face throat angle	Sn-Gn-C	111.2º ± 12.1	95.7º ± 12.4	106.428 ± 6.151	104.844 ± 6.273
Naso labial angle	Cm-Sn-Ls	96.3º ± 14.8	80.7º ± 7.9	86.341 ± 10.683	81.041 ± 11.279

***Table 6.3*: A comparison of the means and standard deviation of angular measurement values of black South African young adolescents, Caucasian North Americans (Legan & Burstone, 1980) and this study of Tswana and non-Tswana subjects**

		African Americans		Current study	
Measurement in degrees	**Landmarks**	**Naidoo and Miles (N = 30)**	**Legan and Burstone**	**Tswana N = 52**	**Non-Tswana N = 25**
Facial convexity angle	Gl-Sn-Pog	107º ± 5.3	120º ± 4.0	169.819 ± 5.108	169.257 ± 5.75
Lower face throat angle	Sn-Gn-C	94.1º ± 10.6	100.0º ± 7.0	105.029 ± 6.106	104.061± 6.432
Naso labial angle	Cm-Sn-Ls	82.6º ± 10.9	102.0º ± 8.0	89.423 ± 12.174	88.412 ± 14.362

CHAPTER 7

7.0 CONCLUSION

In this study Tswana males and females have more protrusive features than Caucasian male and female and more protrusive than African Americans. Tswana males and females are less protrusive than non-Tswana male and females. The Tswana subjects were more convex in facial profile than the non-Tswana subjects. The facial profile values established for Caucasian subjects are not applicable to the Tswana and non-Tswana subjects. There is less nasal depth and projection, less bony chin depth, and a smaller nasiolabial angle in Tswanas and non-Tswanas. Upper and lower lip length and soft tissue thickness of the lips and chin are greater in Tswana and non-Tswana subjects than in Caucasian subjects.

The study further indicates that the facial profile values established for Caucasians cannot be applicable to Tswanas and non-Tswanas. The finding of the present study showed that when planning Orthodontic treatment for Tswana subjects, it may be useful to use a modified set of norms.

RECOMMENDATION

In view of the small samples reported in this study it is recommended that a bigger sample be obtained from the institutions involved in Orthodontics, Orthognathic surgery and craniofacial surgery to formulate a comprehensive data base.

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