DonnishJournals

Donnish Journal of Dentistry and Oral Hygiene
Vol. 5(1) pp. 001-006 April, 2019.
http://www.donnishjournals.org/djdoh
ISSN: 2984-8806

Original Research Article

Role of Genetics in Determining the Dental Morphology and Malocclusion in Families

Fatima Abdullah BinYahya[1], Sara Mansour AlMowinea[1], Rawan Abdulkareem Samara[1], Maha Mohamed Al-Amoudi[1], Bashayer Mesfir Al-Ghamdi[1] and Shahzeb Hasan Ansari[2]*

[1]Dental Interns, Riyadh Elm University, KSA.
[2]Lecturer Preventive Dentistry, Riyadh Elm University, KSA.

Accepted, 18th February, 2019.

Introduction: **Genes play an important role in dental morphology, which is important in detecting the kinship between people and their identity. The study of teeth is an interesting topic which inspires a continuous production of books, especially in teeth morphology. Many studies supported the gene expression theory in dental role, which showed families and groups with same dental features and tooth morphology these variations in people is under the genetic control, but on the other hand dental anomalies and abnormalities is also a co-factor with genes.** ***Materials and methods:*** **This is an observational study, which focused on parents and their children's similarity in tooth morphology. An alginate impression for the upper and lower arch was taken for both parent and child. This was followed by pouring the cast and recording the Ramfjord teeth measurements including height and width. 30 families, 2 persons from each family (one parent and one child) were included in the study.** ***Results:*** **The study participants were also divided on the basis of the parents' marriage statuses and it was noted that 45% had married within their family, whereas 55% married outside their family. The most common type of shape among maxilla and mandible was found to be ovoid. However, the least common was V-shape. A total of eight parent/child pairs exhibited similar shaped jaws.** ***Conclusion:*** **No significant relation was discovered among the parents who got married within or outside families as far as similarity in size and shape of arch was concerned.**

Keywords: Tooth morphology, Genetics, Malocclusion, Arch shape, Roles of genes.

INTRODUCTION

Genes play an important role in dental morphology, which is important in detecting the kinship between people and their identity (*Paul & Stojanowski, 2015).*The study of teeth is an interesting topic which inspires a continuous production of books especially in teeth morphology *(Scott & Irish, 2013).*

In the past, Scientists were relying on small-scale bio-archaeological sites for analyzing human skeletal remnants, mortuary contexts, and reconstruction of cemetery structure. Permanent dental morphology data are often used to identify potential biological relatives to reach the kinship identification of people (*Paul & Stojanowski, 2015).*These early ways and studies in dental anthropology contributed to provide the researchers with many new approaches to explore the relation between genetics and its relation with teeth and improved trends in human evolution and dental genome science *(Townsend et al, 2012)*.

Forensic odontologists rely on the skeletal remnant for a couple of decades, by comparing the dental records concerning with dental morphology and express these features between families and ethnical groups, also they depend on morphology in recognizing anonymous people *(Townsend et al, 2012)*.

Many studies supported the gene expression theory in dental role, which showed families and groups with the same dental features and tooth morphology, these variations in people is under the genetic control, but on the other hand dental anomalies and abnormalities is also in a co-factor with genes *(Zurowski et al, 2018)*, *(Townsend et al, 2012)*.

The main obvious causes of anomalies and abnormalities within dentition are two main factors, genetic and environmental factors. It is not as simple as a clear dichotomy of genes versus environment *(Zurowski et al, 2018)*, *(Townsend etal, 2012)*.Studies founded that these tooth defects were frequently seen in families and associated with other anomalies *(Cobourne, 2007)*.

Till now there is a great need to bridge the gap between the role of molecular events and the extent of variations in human dentition. How genetic, environmental and epigenetic factors interact and affect the formation of a wide variety of dental phenotypes. The huge improvement in instruments available,

**Corresponding Author: Shahzeb Hasan Ansari. Lecturer Preventive Dentistry, Riyadh Elm University, KSA. Email: shahzebhasan@riyadh.edu.sa*

accuracy of the captured photo as well as in records in sizes and shape of the teeth all will help to explain how these factors are related to each other *(Townsend et al, 2009)*, *(Townsend et al, 2012)*.The study of genes in dentistry and environmental influences on human dental variation is important in explaining differences in the dentitions of monozygotic co-twins.

The Structural equation modeling (SEM) theory of twin have been used to assess the contributors of genes and environmental factors in dental similarities and variations in twins without attempting to genes identification, thus (SEM) test the combination between genes and environmental factors *(Townsend et al, 2009)*, *(Townsend et al, 2012)*. It can, therefore, be concluded that siblings with the same parents could have the same tooth imprint with their morphology and dental arch width the child could inherit it from one of his parents or may both of them.

This raises a question that why tooth get effected to genetic variations more than other body tissues? We should first understand the tooth formation stages that pass through first formation of tooth bud followed by the cap and bell stages after that laying down of the enamel and dentin over the crown until the complete formation of crown and root, due to the protected environment in tooth formation if any of these stages got affected during tooth formation this will appear on tooth morphology and shape *(Townsend et al, 2012)*, *(Bernal, 2007)*.

AIMS OF THE STUDY

1. Relation between genes and tooth morphology within families.
2. To compare on the basis of relative's marriages and outside non-relative marriages.

METHODS

Study design and tools

This is an observational study, which focused on parents and their children's similarity in tooth morphology. An alginate impression for the upper and lower arch was taken for both parent and child. This was followed by pouring the cast and recording the Ramfjord teeth measurements including height and width.

Sample size

30families, 2 persons from each family (one parent and one child)

Setting

Dental clinics at Riyadh Elm University, Namuthajiyah Campus.

Inclusion criteria

1. Subjects should be medically fit with no syndromes or other craniofacial or dental malformations or systemic diseases.
2. Subjects with complete permanent dentition
3. Children more than 14 years of age
4. Normal development of dentition with No teeth abnormalities (hypo-plastic teeth, no anomalies in tooth shape, no anomalies in number of teeth, no abrasion, four-cusp molars in the maxilla and five-cusp molars in the mandible).
5. Tooth without fillings, fissure sealing, or prosthetic restoration
6. No previous history of orthodontic treatment with multi-bracket appliances

Exclusion criteria

1. Patients with any syndromes or other craniofacial or dental malformations or systemic diseases.
2. Subjects with primary dentition
3. Children less than 14 years of age
4. Any abnormal development of dentition with teeth abnormalities (hypo-plastic teeth, anomalies in tooth shape, anomalies in number of teeth, abrasions, four-cusp molars in the maxilla and five-cusp molars in the mandible)
5. Tooth with fillings, fissure sealing, or prosthetic restoration
6. Previous history of orthodontic treatment with multi-bracket appliances
7. Patients with periodontal disease

Ethical considerations

Inform consents were signed by the participants and the identity and data of the patients was kept confidential.

Statistical analysis

Data was analyzed using SPSS version 19. Descriptive analysis was used to report gender and marital characteristics. Inferential analysis was used to assess the relationship between clinical characteristics and outcomes. A p-value of less than 0.05 was considered to be significant.

RESULTS

This is a pilot study, which included N=30 pairs of parents and their children. Out of those, 35% were males and 65% females. The study participants were also divided on the basis of the parents' marriage statuses and it was noted that 45% had married within their family, whereas 55% married outside their family. The comparisons were made according to the sizes of incisors, premolars, and molars of parent/child pairs. As far as the dimensions of incisors were concerned, three parent/child pairs had similar sizes recorded. Among the premolars, three parent/child pairs had similar size recorded, whereas six pairs had similar dimensions of molars (Tables 1, 2, 3).

Table 4 represents the different types of shapes participants had and their similarities between each other. The most common type of shape among maxilla and mandible was found to be ovoid. However, the least common was V-shape. A total of eight parent/child pairs exhibited similar shaped jaws. We also compared the sample according to marriage statuses with relation to the teeth dimensions and shape of the jaw. No statistically significant relationship was found as far as the marriage status and size of teeth and shape of jaw is concerned (P-values 0.378 and 0.622 respectively).

DISCUSSION

This study aimed to determine the relationship between genetics and tooth morphology. It can be noted from the results that a very small percentage of parent/child pairs showed similarities among the teeth dimensions.

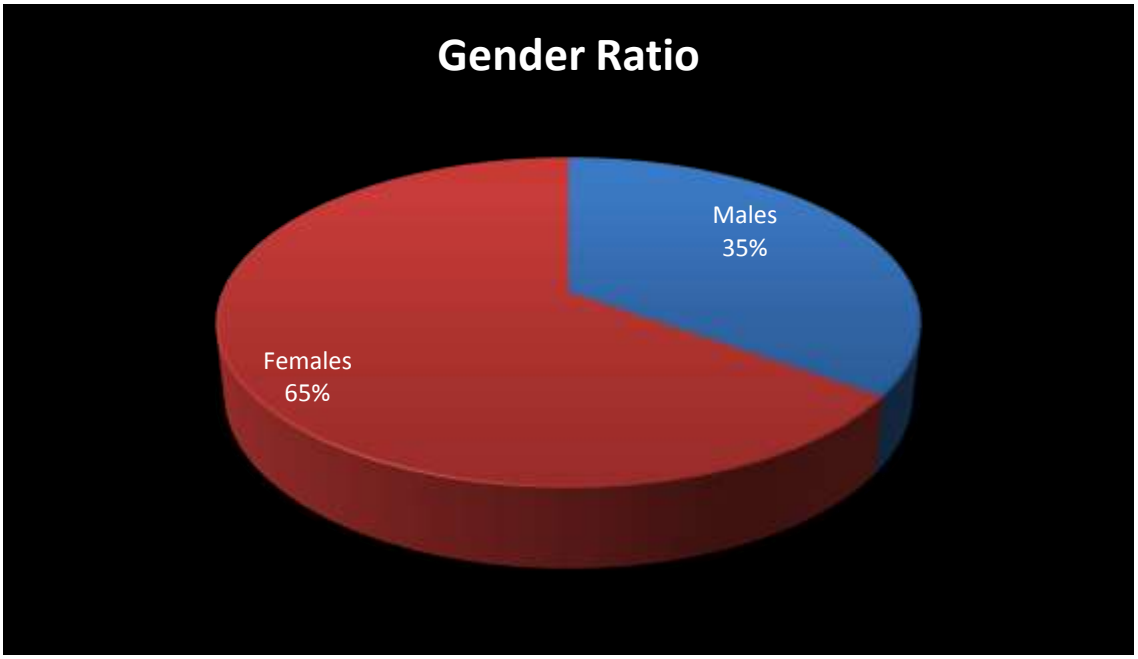

Figure 1: Gender ratio of the participating parent/child pairs in this study.

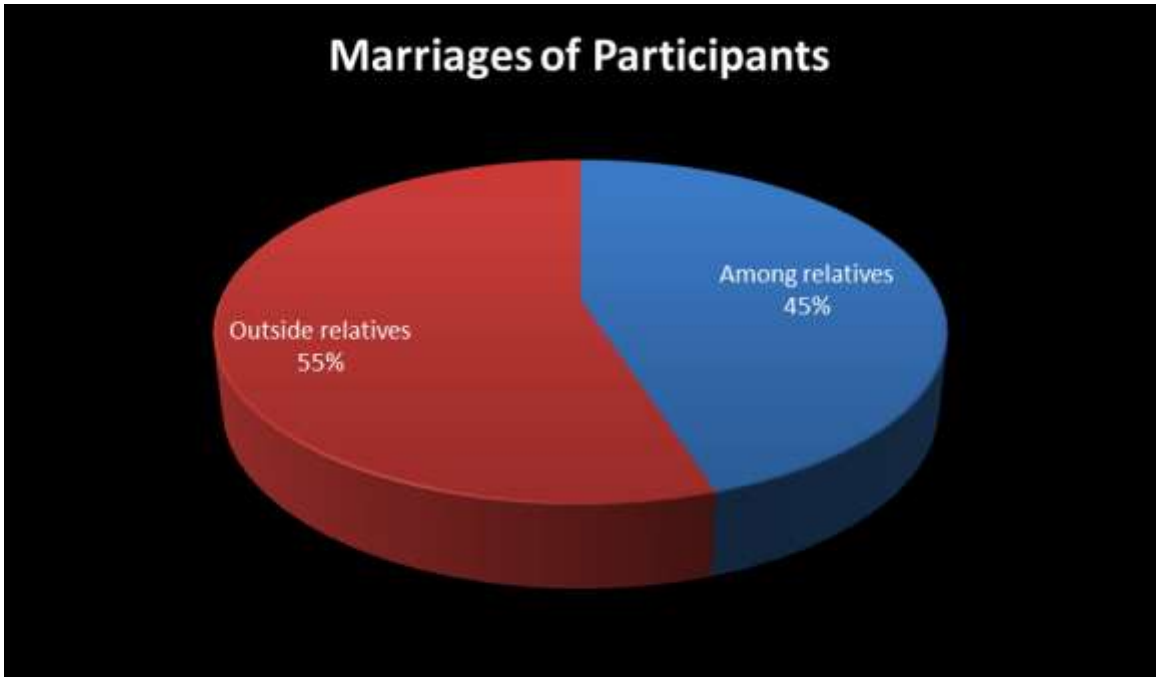

Figure 2: Marriages of study participants either among or outside relatives

Table 1: Heights and widths of incisors of the parent/child pairs

Pair No.	Incisor Comparisons			
	Parent Height (mm)	Child Height (mm)	Parent Width (mm)	Child Width (mm)
1	7	7	6	6
2	9	7	5	6
3	10	9	8	9
4	10	10	9	10
5	9	9	8	10
6	8	9	9	9
7	9	8	8	8
8	8	7	6	6
9	8	10	5	7
10	10	11	8	9
11	8	8	7	7
12	8	9	5	5
13	9	11	10	10
14	7	7	6	6
15	11	10	10	9
16	8	10	5	7
17	10	11	8	9
18	10	10	9	9
19	8	9	5	5
20	9	11	12	10
21	7	7	6	6
22	11	10	10	9
23	7	7	6	6
24	9	7	5	7
25	11	9	8	9
26	9	9	8	10
27	9	9	9	9
28	9	8	8	8
29	10	11	8	9
30	8	8	7	7

Table 2: Heights and widths of premolars of the parent/child pairs

Pair No.	Premolar Comparisons			
	Parent Height (mm)	Child Height (mm)	Parent Width (mm)	Child Width (mm)
1	6	5	6	6
2	5	8	6	8
3	7	7	6	6
4	7	9	7	8
5	7	9	7	7
6	6	6	6	8
7	6	7	8	6
8	6	6	7	7
9	8	8	6	8
10	8	7	7	7
11	7	7	7	7
12	8	7	7	8
13	8	7	8	8
14	7	6	6	9
15	11	8	8	7
16	6	5	6	6
17	5	8	6	8
18	8	8	7	7
19	7	9	7	8
20	9	9	7	7
21	6	6	6	8
22	6	7	8	6
23	5	6	7	7
24	8	8	6	8
25	8	7	7	7
26	7	7	7	7
27	8	7	7	8

28	8	7	8	8
29	7	7	6	6
30	10	8	8	7

Table 3: Heights and widths of molars of the parent/child pairs

Pair No.	Molar Comparisons			
	Parent Height (mm)	Child Height (mm)	Parent Width (mm)	Child Width (mm)
1	6	6	10	10
2	6	6	10	11
3	6	6	10	10
4	7	7	10	10
5	5	4	9	11
6	4	5	10	11
7	5	6	9	10
8	6	6	10	10
9	7	8	11	11
10	7	6	10	11
11	6	6	11	11
12	7	5	12	11
13	7	7	10	10
14	6	5	12	12
15	11	6	11	14
16	7	7	9	9
17	6	6	10	11
18	6	7	10	10
19	8	8	11	11
20	5	4	9	11
21	4	5	10	11
22	5	6	9	10
23	6	6	10	10
24	7	8	12	11
25	7	6	10	11
26	6	6	12	11
27	7	5	12	11
28	7	7	10	10
29	6	5	11	12
30	10	6	11	14

Table 4: Shape of the jaws among parent/child pairs

Pair No.	Maxilla/Mandible Comparisons			
	Parent Maxilla	Child Maxilla	Parent Mandible	Child Mandible
1	Square	Square	Ovoid	Square
2	Ovoid	Ovoid	Ovoid	Ovoid
3	Ovoid	Ovoid	Ovoid	Ovoid
4	Ovoid	Square	Ovoid	Ovoid
5	Square	Square	Square	Ovoid
6	Ovoid	Ovoid	Ovoid	Ovoid
7	Ovoid	Ovoid	Ovoid	Ovoid
8	Ovoid	V-shape	Ovoid	Ovoid
9	Ovoid	Ovoid	V-shape	V-shape
10	Square	Ovoid	Square	Ovoid
11	Ovoid	Ovoid	Ovoid	Ovoid
12	Square	Ovoid	Ovoid	Ovoid
13	Ovoid	Ovoid	V-shape	Ovoid
14	Ovoid	Ovoid	Ovoid	Ovoid
15	Ovoid	Ovoid	Ovoid	Ovoid
16	Square	Square	Ovoid	Square
17	Ovoid	Ovoid	Ovoid	Ovoid
18	Ovoid	Ovoid	Ovoid	Ovoid
19	Ovoid	Square	Ovoid	Ovoid
20	Square	Square	Square	Ovoid
21	Ovoid	Ovoid	Ovoid	Ovoid
22	Ovoid	Ovoid	Square	Ovoid
23	Ovoid	V-shape	Ovoid	Ovoid

24	Ovoid	Ovoid	V-shape	V-shape
25	Square	Ovoid	Square	Ovoid
26	Ovoid	Ovoid	Ovoid	Ovoid
27	Square	Ovoid	Ovoid	Ovoid
28	Ovoid	Ovoid	Ovoid	Ovoid
29	Ovoid	V-shape	Ovoid	Ovoid
30	Ovoid	Ovoid	Square	Ovoid

Table 5: Relationship between marriage status and size of teeth among parent/child pairs

Marriage status	Similar sized teeth	Different sized teeth	P-value
Among relatives	**33%**	**67%**	**0.378**
Outside relatives	**56%**	**44%**	

Table 6: Relationship between marriage status and shape of jaws among parent/child pairs

Marriage status	Similar shaped jaw	Different jaws	P-value
Among relatives	**50%**	**50%**	**0.622**
Outside relatives	**55%**	**45%**	

However, the percentage of these pairs was higher as far as the shape of jaws was concerned. Previously, studies have taken place to demonstrate a relationship between impacted teeth and their relationship with marital statuses have been discussed (Galluccio and Pilotto, 2008). Furthermore, the relationship between tooth morphology and geographic perspective has also been presented with significant findings (Dhamo *et al*, 2017).

Townsend et al (2009) have already explained how genetics plays an important role in determining the shape and size of teeth. However, those findings were based upon the observations made on twins. That is not the case with our study, as no twins were involved since we were not able to find enough samples within the limited time available.

As far as our findings were concerned, we did not observe any statistically significant comparison when relating marital statuses with similar tooth morphology. This was done keeping in mind that marriages within families have a tendency to pass on similar characteristic as far as dental morphology is concerned (Shokry and Alenazy, 2013). We did not find any similar study in order to compare our findings and explain the comparison.

CONCLUSIONS

- Similarities among the parent/child incisors and premolars were found to be less common as compared to the dimensions of molars.
- No significant relation was discovered among the parents who got married within or outside families as far as similarity in size and shape of arch was concerned.

CONFLICT OF INTEREST

There was no conflict of interest declared by any of the authors.

REFERENCES

1. Bernal, V., 2007. Size and shape analysis of human molars: comparing traditional and geometric morphometric techniques. HOMO-Journal of Comparative Human Biology, 58(4), pp.279-296.
2. Cobourne, M.T., 2007. Familial human hypodontia–is it all in the genes?. British dental journal, 203(4), p.203.
3. Dhamo B, Kragt L, Grgic O, Vucic S, Gomez CM, Rivedeneira F, Jaddoe VWV, Wolvius EB and Ongkoswito EM, 2017. Ancestry and dental development: a geographic and genetic perspective. American Journal of Physical Anthropology, 165(2).
4. Echtermeyer, S., Metelmann, P.H., Hemprich, A., Dannhauer, K.H. and Krey, K.F., 2017. Three-dimensional morphology of first molars in relation to ethnicity and the occurrence of cleft lip and palate. PloS one, 12(10), p.e0185472.
5. Galluccio G and Pilotto A, 2013. Genetics of dental agenesis: anterior and posterior area of the arch. European Archives of Pediatric Dentistry, 9(1), pp. 41-45.
6. Paul, K.S. and Stojanowski, C.M., 2015. Performance analysis of deciduous morphology for detecting biological siblings. American journal of physical anthropology, 157(4), pp.615-629.
7. Scott, G.R. and Irish, J.D. eds., 2013. Anthropological perspectives on tooth morphology: genetics, evolution, variation (Vol. 66). Cambridge University Press.
8. Shokry SM and Alenazy MS, 2013. Consanguinity-related hyperdontia: an orthopantomographic study. Dental Research Journal, 10(6), pp. 732-736.
9. Townsend, G., Bockmann, M., Hughes, T. and Brook, A., 2012. Genetic, environmental and epigenetic influences on variation in human tooth number, size and shape. Odontology, 100(1), pp.1-9.
10. Townsend, G., Hughes, T., Luciano, M., Bockmann, M. and Brook, A., 2009. Genetic and environmental influences on human dental variation: a critical evaluation of studies involving twins. Archives of Oral Biology, 54, pp.S45-S51.
11. Zurowski, C., Jamniczky, H., Graf, D. and Theodor, J., 2018. Deletion/loss of bone morphogenetic protein 7 changes tooth morphology and function in Mus musculus: implications for dental evolution in mammals. Royal Society Open Science, 5(1), p.170761.