Cheiloscopy: A new role as a marker of sagittal jaw relation

Narayan Kulkarni,
Vasudevan SD,
Romil Shah, Parikshit Rao,
Aswini Y Balappanavar1
Department of Orthodontics and Dentofacial Orthopedics,
KM Shah Dental College and Hospital, Sumandeep Vidyapeeth, Pipariya, Waghoria, Vadodara, Gujarat, 1Department of Public Health Dentistry, Teerthanker Mahaveer Dental College and Research Centre, Moradabad, Uttar Pradesh, India

Address for correspondence:
Dr. Narayan Kulkarni,
Department of Orthodontics and Dentofacial Orthopedics,
KM Shah Dental College and Hospital, Pipariya - 391 760, Waghoria, Vadodara, Gujarat, India.
E-mail: drorthonaru@gmail.com

Abstract

Context: It has been proved that lip prints are analogous to thumb prints. A correlation between thumb prints and sagittal dental malocclusion has already been established. Soft tissue is gaining more importance in judgement of deformity or identity of a patient. Aim: To find a correlation between sagittal skeletal jaw relation and lip prints. Settings and Design: Descriptive, cross-sectional, comparative, single-blind, hospital-based study. Materials and Methods: A total of 90 patients were categorized into skeletal class I, class II, and class III, comprising 30 patients in each group with equal gender distribution. Dolphin imaging (10.5) software was used for analyzing sagittal jaw relation. Lip prints obtained from these 90 patients were analyzed. Statistical Analyses Used: Karl Pearson’s correlation coefficient, Chi-square test, t-test, Spearman’s co-efficient, analysis of variance (ANOVA). Results: It was observed that angle ANB (Angle formed between points nasion[N] to Subnasal[A] and nasion[N] to supramental [B]) and beta angle were statistically significant, revealing a strong negative correlation (-0.9060) with different classes of jaw relation. Significant difference was observed between genders in all the three classes. Significant difference was observed in relation to lip print and the quadrants of upper and lower lips. A statistical significance was noted on the right side of both upper and lower arches. Conclusion: This study shows that lip prints can be employed for sagittal jaw relation recognition. A further study on various ethnic backgrounds with a larger sample size in individual group is necessary for comparing lip prints and malocclusion.

Key words: ANB, beta angle, cheiloscopy, lip prints, sagittal jaw relation, WITS appraisal

Introduction

Every human being is distinct and discernible in that they exhibit their own pattern of characteristics.[1] Lip prints are normal lines and fissures in the form of wrinkles and grooves present in the zone of transition of human lip, between the inner labial mucosa and outer skin, the examination of which is referred to as “cheiloscopy.”[2,3]

The biological phenomenon of systems of furrows on the red part of human lips was first described by an anthropologist Fischer in 1902, as quoted by Sivapathasundaram et al.[3] However, until 1930, anthropology merely mentioned the existence of furrows without suggesting a practical use for the phenomenon. In 1961, the first research in Europe was carried out on the subject of lip prints in Hungary. Lip print evaluation gained importance when lip traces were found on a glass door at the scene of murder.[3,4] The search for cheiloscopic correlation to various other factors is yet unanswered.

Earlier studies have indicated that lip prints can be used for personal identification as well as sex determination.[2,3] Mc Donel in 1972 studied identical twins and concluded that both the lip prints showed some similarities as told by Agarwal.[4] It has been proved that lip prints are analogous
to thumb prints. A correlation between thumb prints and sagittal dental malocclusion has already been established. It is stated that fingers, palms, lip, alveolus, and palate develop during the same embryonic period. Lip prints are established at a very early period in comparison to sagittal jaw relation and dental relation. Establishing a correlation between sagittal jaw relation and lip prints would benefit the clinician by predicting the type of malocclusion and can also provide additional information on individual personal identity. No previous studies reported on the correlation between lip prints and sagittal jaw relation. The aim of our study was to find out any correlation that exists between cheiloscopy and sagittal skeletal jaw relations. The objective was to compare the gender variation of lip prints and of sagittal skeletal jaw relation as well as to relate the different lip print patterns with those of sagittal skeletal jaw relations.

Materials and Methods

A descriptive, cross-sectional, single-blind, hospital-based study was conducted in the Department of Orthodontics and Dentofacial Orthopedics. Ethical clearance was obtained from the ethical committee of the Sumandeep Vidyapeeth university. Informed consent was obtained from each subject prior to the study. Patients having any developmental anomaly or any pathology on lips and jaws, those who were unable to open their mouth, and those who did not give informed consent were excluded from the study. A pilot study was conducted on 15 patients (5 in each group) to know the feasibility and acceptability of the study. Based on secondary literature available, a sample size of 90 subjects was found to be appropriate. A convenience sample of 90 patients, in the age group of 18–25 years, from the outpatient Department of Orthodontics was included in our study.

Digital lateral cephalogram
The digital cephalograms were recorded with Kodak 8000C machine utilized for taking both lateral cephalogram and orthopantomographs. For taking the cephalograms, 6 kV, 12 mA current and an exposure time of 0.8 sec was used. Images were recorded on a CCD and were processed with the help of Kodak dry view 8150. All 90 digital cephalograms were analyzed using Dolphin imaging (10.5) software.

Establishment of sagittal jaw position
Determining skeletal jaw relation is dependent on factors like position of maxilla and mandible with reference to cranial base. Establishing a correlation between sagittal jaw relation and lip prints would benefit the clinician by predicting the type of malocclusion and can also provide additional information on individual personal identity. No previous studies reported on the correlation between lip prints and sagittal jaw relation. The aim of our study was to find out any correlation that exists between cheiloscopy and sagittal skeletal jaw relations. The objective was to compare the gender variation of lip prints and of sagittal skeletal jaw relation as well as to relate the different lip print patterns with those of sagittal skeletal jaw relations.

Table 1: Various cephalometric parameters for sagittal jaw position

| Cephalometric analyses                  | Parameters                | Readings for normal jaw position |
|-----------------------------------------|---------------------------|---------------------------------|
| Downs analysis (angular measurements)  | Facial angle              | 82°–95°                         |
|                                         | Angle of convexity        | −8.5° to 10°                    |
|                                         | A-B plane angle           | 0° to −9°                       |
| Steiner analysis (angular measurements) | Angle SNA                 | 82°                             |
|                                         | Angle SNB                 | 80°                             |
| McNamara analysis (linear measurements) | Point A to N- perpendicular| 0–1 mm                          |
|                                         | Pog to N perpendicular    | Large: −2 to +5 mm              |

Figure 1: Lateral cephalometric analysis done by Dolphin imaging 10.5

Figure 2: Representing various planes used for determining cephalometric sagittal jaw relation
number of males and females) was taken and 30 subjects (15 males and 15 females) were assigned to each group (i.e., class I, class II, and class III). Dolphin imaging (10.5) software was employed for a second time to achieve specific details like angle ANB,[10,11] WITS appraisal,[13,15] and beta angle.[14] Keeping the norms into consideration, the cephalograms were categorized into class I, class II, and class III when at least two norms coincided, according to Jacobson and Baik, as mentioned in Table 2.[10,14,16] All cephalometric analyses were performed by one individual to prevent any inter-observer bias.

Lip print recording
A dark-colored lipstick was applied uniformly with one stroke on upper and lower lips. Patient was asked to rub upper and lower lip. After 2 minutes, lip impression was made on a transparent self-adhesive tape having a width of 48 mm. This lip impression was immediately pasted on a white bond paper as proposed by Sivapathasundaram et al.[3] Magnifying glass lens was used for the analysis of lip prints and the field of observation was restricted to 10 mm on each side of the quadrant.[2,3] All lip print analyses [Figures 3 and 4] were done by another observer who was blinded in relation to clinical examination and cephalometric analysis of the patient. Tsuchihashi’s classification of lip print [Figure 5] was used to analyze the lip prints.[1]

Tsuchihashi’s classification for lip print identification
Courtesy Dr. Sivapathasundharam B, Dr. Ajayprakash P, and Dr. Sivakumar G[3]

Table 2: Various cephalometric parameters for sagittal jaw relation

| Cephalometric analyses | Parameters | Skeletal class I jaw relation | Skeletal class II jaw relation | Skeletal class III jaw relation |
|------------------------|------------|-----------------------------|-------------------------------|--------------------------------|
| Angle ANB              | Inside inferior angle between line N to point A and N to point B | 2°                           | >2°                           | <-1°                           |
| WITS appraisal         | A0 to B0 on occlusal plane | Males: −2 to +4 mm Females: −4.5 to +1.5 mm | Males: >+4 mm Females: >+1.5 mm | Males: >−2 mm Females: >−4.5 mm |
| Beta angle             | Internal angle measured at point A between A–B line and a perpendicular line drawn on CB line from point A | 27° and 35°                   | <27°                          | >35°                           |

Statistical analyses
SPSS 16.0 version software was used for statistical analysis. A confidence interval of 95% and a significance level of 5% were set. Comparison of three skeletal groups, class I, class II, and class III, with respect to angle ANB, WITS appraisal, and beta angle was made by one-way analysis of variance (ANOVA) and Tukey’s multiple post hoc procedures. Correlation among all the parameters in class I, class II, and class III groups was determined by Karl Pearson’s correlation coefficient method. Chi-square test was utilized to analyze significance of lip prints in terms of gender, quadrant, and among all the three sagittal groups. Spearman’s correlation was used to compare lip prints and sagittal jaw relation.

Results
There were 30 subjects each in the three groups, accounting to a total of 90 subjects. The mean age of the study subjects was 19.5 ± 2.97 years. There was a significant difference in
age when the three groups (class I 19.37 ± 3.22 years, class II 18.53 ± 2.75 years, class III 20.70 ± 2.94 years) were compared \( (P=0.0001, S) \).

The mean value of angle ANB (in mm) was 1.93 ± 0.45, 7.27 ± 1.11, and -3.7 ± 1.73 for skeletal class I, class II, and class III, respectively [Graph 1]. Mean value of WITS appraisal (in mm) was 0.33 ± 0.96, 4.44 ± 1.9, and -2.50 ± 0.86 for skeletal class I, class II, and class III, respectively, as observed in Graph 2. Beta angle (in mm) had a mean value of 29.23 ± 2.33, 23.93 ± 1.96, and 38.67 ± 2.44 for skeletal class I, class II, and class III, respectively [Graph 3]. Karl Pearson’s correlation co-efficient indicated statistically significant difference between skeletal class I, class II, and class III with respect to angle ANB, WITS appraisal, and beta angle [Table 3]. When gender was taken as a variable and compared for angle ANB \( (P=0.54, NS) \), WITS appraisal \( (P=0.35, NS) \), and beta angle \( (P=0.76, NS) \), there was no significant difference.

Lip prints were examined in relation to upper and lower lips which were further subdivided into right and left quadrants. Among all the four quadrants, it was observed

| Table 3: Correlation among all the parameters in total samples of all three groups by Karl Pearson’s correlation coefficient method |
|---------------------------------------------------------------|
| **Variables** | **ANB** | **WITS** | **Beta angle** |
|----------------|---------|----------|----------------|
| **ANB**        | 1.0000  |          |                |
| **WITS**       | 0.7067  | 1.0000   |                |
| **Beta angle** | -0.9060*| -0.7514  | 1.0000         |

* \( P<0.05 \)

Figure 5: Suzuki and Tsuchihashi’s classification of lip print [(courtesy Dr. Sivapathasundaram B, Dr. Ajayprakash P, and Dr. Sivakumar G, Lip prints (cheiloscopy) Indian J Dent Res, 10:234-37, 2001)]

Graph 1: Comparison of three groups with respect to ANB values. F-value = 613.0771, \( P=0.0000, S \)

Graph 2: Comparison of three groups with respect to WITS values. F-value = 351.3208, \( P=0.0000, S \)

Graph 3: Comparison of three groups with respect to Beta angle values. F-value = 328.9314, \( P=0.0000, S \)
that a combination of 1,3; 1′,3; and 2,3 types of lip prints were predominant in skeletal class I group of individuals. 1,4 and 3,4 types of lip print combinations were predominant among skeletal class III group of patients. 1,2 type of lip print combination was observed to be more predominant among skeletal class II individuals as observed in Tables 4 and 5. A significant difference was observed among skeletal class I, class II, and class III groups. Right quadrant in both upper and lower lips revealed statistical significance.

There was an association of combination of lip print patterns with respect to angle ANB, WITS appraisal, and beta angle as shown in Table 6, whereas individual lip prints did not show any significance. There was significant difference when angle ANB was compared with lip print patterns on upper and lower lips. However, the upper right lip print combinations (1–4) were not significant (P=0.0939). WITS appraisal had a statistically strong association with that of lip print patterns. Beta angle showed no significant association with the lower right and left lip print combinations (1–4) but had a significant relation on the same side with 1′,1 combination of lip prints as shown in Table 6.

Regarding the gender difference, females had more of 1′ (75.66%), 1 (58.98%), 3 (55.77%), and 4 (73.11%) types of lip print patterns when compared to males. Lip print pattern 2 was more common among males (61.3%).

**Discussion**

Thumb prints, lip prints, and dental examination are routinely used for forensic examination.\[1,11\] It has been proved that lip prints are analogous to thumb prints and is confirmed that specific lip prints are common among individuals of specific gender.\[2,3\] Profile photograph indicates probable sagittal skeletal relation and can

---

**Table 4: Distribution of study subjects according to groups and types of lip prints in upper lip**

| Types of lip prints | Upper right side | Upper left side |
|---------------------|------------------|-----------------|
|                     | Class I | Class II | Class III | Total | Class I | Class II | Class III | Total |
| 1,3                 | 9 30.0  | 0 0.00  | 0 0.00    | 9 30.0 | 9 30.0  | 0 0.00  | 0 0.00    | 9 30.0 |
| 1′,3                | 10 33.3 | 0 0.00  | 0 0.00    | 10 33.3 | 9 30.0  | 0 0.00  | 0 0.00    | 9 30.0 |
| 2,3                 | 10 33.3 | 3 10.0  | 0 0.00    | 13 33.3 | 9 30.0  | 4 13.3  | 0 0.00    | 13 43.0 |
| 1,2                 | 0 0.00  | 24 80.0 | 0 0.00    | 24 80.0 | 0 0.00  | 22 73.3 | 1 3.33    | 23 76.6 |
| 1′,2                | 0 0.00  | 2 6.67  | 0 0.00    | 2 6.67  | 2 6.66  | 2 6.67  | 0 0.00    | 4 13.3  |
| 1,1′                | 1 3.40  | 1 3.33  | 0 0.00    | 2 6.73  | 0 0.00  | 1 3.33  | 0 0.00    | 1 3.33  |
| 1,4                 | 0 0.00  | 0 0.00  | 19 63.3   | 19 63.3 | 0 0.00  | 0 0.00  | 18 60.0   | 18 60.0 |
| 1′,4                | 0 0.00  | 0 0.00  | 1 3.33    | 1 3.33  | 0 0.00  | 0 0.00  | 2 6.67    | 2 6.67  |
| 2,4                 | 0 0.00  | 0 0.00  | 0 0.00    | 0 0.00  | 1 3.33  | 1 3.33  | 0 0.00    | 2 6.67  |
| 3,4                 | 0 0.00  | 0 0.00  | 10 33.1   | 10 33.0 | 0 0.00  | 0 0.00  | 9 30.0    | 9 30.0  |
| Total               | 30 100  | 30 100  | 30 100    | 90 300  | 30 100  | 30 100  | 30 100    | 90 300  |

Chi-square = 58.6960; df = 4; *P=0.00, S

**Table 5: Distribution of study subjects according to groups and types of lip prints in lower lip**

| Types of lip prints | Lower right side | Lower left side |
|---------------------|------------------|-----------------|
|                     | Class I | Class II | Class III | Total | Class I | Class II | Class III | Total |
| 1,3                 | 9 31.0  | 0 0.00  | 0 0.00    | 9 31.0 | 14 46.7 | 1 3.33  | 1 3.33    | 16 53.4 |
| 1′,3                | 10 33.3 | 0 0.00  | 0 0.00    | 10 33.3 | 7 23.0  | 0 0.00  | 0 0.00    | 7 23.0  |
| 2,3                 | 10 33.3 | 3 10.0  | 0 0.00    | 13 43.3 | 9 30.0  | 4 13.3  | 0 0.00    | 13 43.3 |
| 1,2                 | 0 0.00  | 24 80.0 | 0 0.00    | 24 80.0 | 0 0.00  | 21 70.0 | 0 0.00    | 21 73.3 |
| 1′,2                | 0 0.00  | 2 6.67  | 0 0.00    | 2 6.67  | 0 0.00  | 2 6.67  | 0 0.00    | 2 6.67  |
| 1,1′                | 1 3.40  | 1 3.33  | 0 0.00    | 2 6.73  | 0 0.00  | 1 3.33  | 0 0.00    | 1 3.33  |
| 1,4                 | 0 0.00  | 0 0.00  | 19 63.3   | 19 63.3 | 0 0.00  | 0 0.00  | 15 50.0   | 15 50.0 |
| 1′,4                | 0 0.00  | 0 0.00  | 1 3.33    | 1 3.33  | 0 0.00  | 0 0.00  | 1 3.33    | 1 3.33  |
| 2,4                 | 0 0.00  | 0 0.00  | 0 0.00    | 0 0.00  | 1 3.33  | 1 3.33  | 0 0.00    | 1 3.33  |
| 3,4                 | 0 0.00  | 0 0.00  | 10 33.0   | 10 33.0 | 0 0.00  | 0 0.00  | 13 43.3   | 13 43.3 |
| Total               | 30 100  | 30 100  | 30 100    | 90 300  | 30 100  | 30 100  | 30 100    | 90 300  |

Chi-square = 36.4665; df = 4; *P=0.00, S

---

**Type 1**: Clear-cut grooves running vertically across the lips; **Type 1′**: Straight grooves which disappear half way instead of covering the entire lip; **Type 2**: Fork grooves in their course; **Type 3**: Intersecting grooves; **Type 4**: Reticulate grooves; **Type 5**: Undetermined.
be used for personal identification. Probability of trauma and sublimation of records occurs more on soft tissue. Hence, dental records are gaining more importance nowadays, and an attempt was made to correlate sagittal skeletal jaw relation with the type of lip prints. As there is lack of literature for this relation, valid comparisons could not be made with other studies. Among all the four quadrants of the lip, it was observed that 1,3; 1,3; and 2,3 types of lip print combinations were predominant in skeletal class I group of individuals. 1,4 and 3,4 types of lip print combinations were predominant among skeletal class III group of patients. 1,2 type of lip print combination was observed to be more predominant among skeletal class II group of patients. Statistically significant difference was noted between angle ANB and beta angle, revealing a strong negative correlation (-0.9060).

### Sagittal jaw relation

The angular and linear measurements in various analyses that have been proposed for anteroposterior measurement could be inaccurate because they depend on various factors. Hence, an accurate assessment of anteroposterior jaw relationship is critical. In the present study, the mean values of angle ANB were 1.93 ± 0.45, 7.27 ± 1.11, and -3.7 ± 1.73 for skeletal class I, class II, and class III, respectively. This observation is in concurrence with earlier literature.

| Lip print pattern | ANB | WITS | Beta angle |
|------------------|-----|------|------------|
| UR1 (upper right) | -0.1777 | -1.6935 | 0.1639 |
| UR2 (upper right) | -0.8669 | -16.3130 | 0.0000* |
| UL1 (upper left) | -0.1548 | -1.4702 | 0.1451 |
| UL2 (upper left) | -0.8757 | -11.9893 | 0.0000* |
| LL1 (lower left) | 0.2939 | 2.8849 | 0.0049* |
| LL2 (lower left) | -0.8318 | -14.0568 | 0.0000* |
| LR1 (lower right) | 0.3002 | 2.9518 | 0.0040* |
| LR2 (lower right) | -0.1958 | -14.3136 | 0.0000* |

Table 6: Correlation of ANB, WITS, and beta angles, with lip print pattern by Spearman’s rank correlation

### Acknowledgments

We would like to thank the participants for their cooperation throughout the study procedure. I thank my Head of the
Department, my colleagues for guidance, and the post graduate students for the support extended to me during the study. I also thank Dr. Aswini Y. B., Reader, Department of Public Health Dentistry, and Dr. Varun Sardana, Senior Lecturer, Department of Pedodontics and Preventive Dentistry, Teerthanker Mahaveer Dental College, Moradabad, for extending their special help to me in editing and reviewing the manuscript.

References

1. Tsuchihashi. Studies on personal identification by means of lip prints. Forensic Sci 1974;3:233-48.
2. Sharma P, Saxena S, Rathod V. Cheiloscopy; the study of lip prints in sex identification. J Forensic Dent Sci 2009;1:24-7.
3. Sivapathasundaram B, Prakash PA, Sivakumar G. Lip prints (cheiloscopy). Indian J Dent Res 2001;12:234-7.
4. Agarwal A. The importance of lip prints (forensic files). Available from http://lifeeloom.com/IIAgarwal.html.[Last Accessed from 2008, Oct 24].
5. Tikare S, Rajesh G, Prasad KW, Thippeswamy V, Jvali SB. Dermatoglyphics–a marker for malocclusion? Int Dent J 2010;60:300-4.
6. Kanematsu N, Yoshida Y, Kishi N, Kawata K, Kaku M, Maeda K, et al. Study on abnormalities in the appearance of finger and palm prints in children with cleft lip, alveolus, and palate. J Maxillofac Surg 1986;14:74-82.
7. Profit WB, Fields HW, Sarver DM. Contemporary Orthodontics. (4th ed). Missouri: Mosby imprint, Elsevier; 2007. p. 195.
8. Jacobson A, Jacobson RL. Radiographic Cephalometry: From Basics to 3-d Imaging. (2nd ed). Illinois: Quintessence Publishing; 2006. p. 72.
9. Jacobson A, Jacobson RL. Radiographic Cephalometry: From Basics to 3-d Imaging. (2nd ed). Illinois: Quintessence Publishing; 2006. p. 99.
10. Jacobson A, Jacobson RL. Radiographic Cephalometry: From Basics to 3-d Imaging. (2nd ed). Illinois: Quintessence Publishing; 2006. p. 112-22.
11. Cavard S, Alvarez JC, De Mazancourt P, Tilotta F, Brousseau P, de la Grandmaison GL, et al. Forensic and police identification of “X” bodies. A 6-years French experience. Forensic Sci Int 2011;204:139-43.
12. Lynnerup N, Bojesen S, Kuhlman MB. Matching profiles of masked perpetrators: A pilot study. Med Sci Law 2010;50:200-4.
13. Valenzuela A, Martin-de las Heras S, Marques T, Exposito N, Bohoyo JM. The application of dental methods of identification to human burn victims in a mass disaster. Int J Legal Med 2000;113:236-9.
14. Baik CY, Ververidou M. A new approach of assessing sagittal discrepancies: the Beta angle. Am J Orthod Dentofacial Orthop 2004;126:100-5.
15. Gul-e-Erum, Fida M. A comparison of cephalometric analyses for assessing sagittal jaw relationship. J Coll Physicians Surg Pak 2008;18:679-83.
16. Vahanwala S, Parekh BK. Study of lip prints as an aid to forensic methodology. JDI 2000;71:268-71.
17. Patel HM, Joshi MR. A study of the differences between the dento-facial patterns associated with Class II division I malocclusion and normal occlusion. J Indian Orthod Soc 1977;9:1-10.
18. Vahanwala S, Nayak CD, Pagare SS. Study of Lip – Prints as Aid for sex determination. Medico legal update 2005;5:93-8.
19. El Domiaty MA, Al-gaidi SA, Elayat AA, Safwat MD, Galal SA. Morphological patterns of lip prints in Saudi Arabia at Almadinah Almonawarab province. Forensic Sci Int 2010;200:179.
20. More C, Patil R, Asrani M, Gondivkar S, Patel H. Cheiloscopy – A Review. Indian J Forensic Med Toxicol 2009;3:17-20.

How to cite this article: Kulkarni N, Vasudevan SD, Shah R, Rao P, Balappanavar AY. Cheiloscopy: A new role as a marker of sagittal jaw relation. J Forensic Dent Sci 2012;4:6-12.
Source of Support: Nil, Conflict of Interest: None declared

Author Help: Online submission of the manuscripts

Articles can be submitted online from http://www.journalonweb.com. For online submission, the articles should be prepared in two files (first page file and article file). Images should be submitted separately.

1) First Page File:
   Prepare the title page, covering letter, acknowledgement etc. using a word processor program. All information related to your identity should be included here. Use text/rtf/doc/pdf files. Do not zip the files.

2) Article File:
   The main text of the article, beginning with the Abstract to References (including tables) should be in this file. Do not include any information (such as acknowledgement, your names in page headers etc.) in this file. Use text/rtf/doc/pdf files. Do not zip the files. Limit the file size to 1 MB. Do not incorporate images in the file. If file size is large, graphs can be submitted separately as images, without their being incorporated in the article file. This will reduce the size of the file.

3) Images:
   Submit good quality color images. Each image should be less than 4 MB in size. The size of the image can be reduced by decreasing the actual height and width of the images (keep up to about 6 inches and up to about 1800 x 1200 pixels). JPEG is the most suitable file format. The image quality should be good enough to judge the scientific value of the image. For the purpose of printing, always retain a good quality, high resolution image. This high resolution image should be sent to the editorial office at the time of sending a revised article.

4) Legends:
   Legends for the figures/images should be included at the end of the article file.