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Study of Relative Variation of Area of Heart-Sound Triangle in 3- to 10-Year-Old Boys

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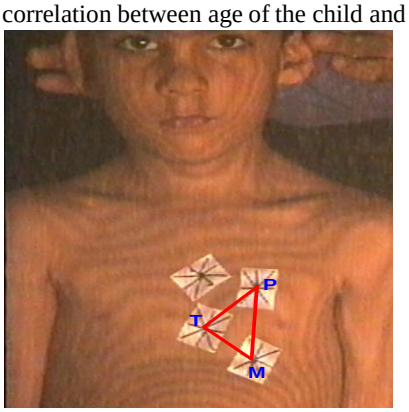
Heart is one of the most important organs of human body. Cardiac care occupies a very important role in the total well being of a person. However, the stressful life of the third millennium has, also, increased heart problems. Therefore, there is an increasing emphasis on the modeling of heart function. If one auscultates the chest, maximum intensity of sound is obtained at three locations corresponding to the pulmonary (P), tricuspid (T) and mitral (M) valves. Data were obtained on 30 boys, 3-10-year old (average age 5.25 years), studying in Sunrise Public School, Karachi. Hearts of students were auscultated in lying, sitting, standing and squatting positions. A study of relative variation of area of heart-sound triangle, ΔPTM, in these ages was conducted and mathematical relation derived to justify this study. Data were analyzed using MATLAB-based software to predict the expected correlation between age of the child and ratio of body-area to area of heart-sound triangle. The results indicated positive correlation close to unity (lower limit +0.99), suggesting the ratio to be directly proportional to age of under-11 child. Further, it was noted that there was no change in the area of the heart-sound triangle for readings taken in various positions (lying, sitting, standing and squatting). A moiré photograph of the chest taken after stickers were placed at these positions gave a two-dimensional projection of the body surface as well as information of third dimension by noting down the number of moiré fringe intersecting the sticker point and computing distance from moiré grid by applying depth-moiré-fringe-number relationship. The sides and the angles of the 2-D-heart-sound triangle (governed by Euclidean geometry), were measured from this photograph — in 3-D, ΔPTM is a union of PT, TM and MP curves (governed by Riemannian geometry). Hence, by taking moiré patterns and subsequent analysis by a suitable algorithm, one may determine surface anatomy of the chest. One may, also, reconstruct shape of the heart in 3-D using this technique (the idea of heart-shape reconstruction by knowledge of height map was, originally, given by SAK, who was MPhil supervisor of MW — the concept was, subsequently, reported in MPhil thesis and related paper of MW). A further enhancement could be obtaining rasterstreograph with stickers placed on the skin. Such a set up would give local curvatures of the points of maximum intensity (PMI). These two sets of information, if interpreted properly, could alert family-health physicians to many underlying problems of heart. Moiré and raster techniques are non-contact, non-invasive and pose no health risk to growing children. It is recommended that screening of heart function combined with moiré fringe topography and rasterstereography be integrated into the national health priorities of the third millennium. This screening would become more effective if moiré and raster pictures of ears and face are, also, included, as there are indications that heart problems may affect shape of ears. Further, studies should focus on counterclockwise rotation of heart (as viewed from front) about the antero-posterior axis as the age of child increases. This could be accomplished by writing rotational equations in cardiac coördinates proposed earlier in acoustic model of heart, which visualized the organ as a deformed ellipsoid-of-revolution.



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