Geographic Information System for Cleft lip and Palate Support: A Pilot Study

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Abstract

As oro-facial cleft patients require prolonged treatment and follow-up, it is necessary to study the geographic distribution so that they get on-time treatment. A multispecialty hospital-based retrospective record-based study was conducted. Geographic information system (GIS) was used to visualize the distribution of patients with cleft lip and/or palate visiting the multispecialty hospital in Udupi, Karnataka, India. A briefcase with minimum data sets [profile] for all individuals was prepared and a GIS prototype prepared. The GIS data is useful in improving the connectivity between hospitals and communities by planning outreach programs, follow up on treatment, and thereby improve the care of cleft lip and palate individuals.

Clinical relevance: This article provides readers with an understanding of the Geographic Information System the can be utilized to improve the connectivity between hospitals and communities for better cleft care.

Keywords: Geographic information system, GIS, cleft lip, cleft palate, orofacial clefts.

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Introduction

The most common congenital craniofacial malformation is Cleft lip and/or palate. Orofacial clefts affect not just the child's physical appearance but also nutrition, speech, hearing, psychological wellbeing, and social integration.[1-5] Some of these disabilities can be averted by having a multidisciplinary treatment approach involving otolaryngologists, plastic surgeons, maxillofacial surgeons, orthodontists, speech therapist, pediatricians, nurses, genetics counselors, audiologists, psychologists, and social workers.[6] As these patients require prolonged treatment and follow-up, it is necessary to study the geographic distribution so that they get on-time treatment.

Geographic information system (GIS) is a well-established set of tools for displaying and manipulating spatial data which can help in optimizing surgical, dental, speech, and psychological outcomes for these patients. GIS leads to a better understanding between the environment and health while at the same time providing healthcare providers with a rapid understanding of the locations where problems occur most often, enabling the continuous process of planning, monitoring, and evaluating oral health services.

Web GIS stores data on a central server that can be accessed from various terminals via the internet or intranet.[7] Dynamic maps can be created and published on the web to assist patients in quickly locate the most convenient health care facility.

Combining epidemiological, statistical, and spatial knowledge will improve the healthcare system considerably.

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Hence the objective of this study was to develop an information system model for geographic distribution of cleft lip and palate diagnosed (ICD 10) individuals for prospective care, research, and advocacy.

Material and methods

A multispecialty hospital-based retrospective record-based study was conducted from 2014 to 2016. The study was in accordance with the ethical standards of institutional ethical committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. The data comprised records of the patients with cleft lip and palate (International classification of diseases ICD-10, Q35, Q36, Q37) visiting the multispecialty hospital in Udupi, Karnataka, India.

All 61 cases from 2014 to 2016, diagnosed with cleft lip and/or palate were recruited for the study. Basic information from the hospital and patient records was collected. Statistical analysis was performed using SPSS software program (IBM SPSS Statistics 20)

The data was incorporated into a spreadsheet format (excel 2016, Microsoft) and converted for GIS use (Version ArcGIS). The geographic distribution of the subjects was based on the PIN code.

GIS software was used to illustrate the district layer and distribution of patients. Gender-specific maps and diagnosis-specific maps were also constructed.

Results

The topography and geographic maps were created as the base for the GIS study. (Figure 1) Geographic maps from 2014 through 2016 were created for all cleft patients (n-61). Gender-specific maps revealed 38 (62.3%) were females and 23 (37.7%) were males (Figure 2).

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Patients with cleft palate (Q35, 62.3%) constituted the maximum prevalence, followed by cleft lip and palate (Q37, 23%) and cleft lip (Q36,14.8%).

GIS analysis revealed expansion in the catchment area from 2014 to 2016 for patients with cleft lip and/or palate extending to Karnataka's borders.

Clustering was noted in Udupi district (Figure 3). The geographical distribution indicated the majority of the patients (59%) lived in Udupi district, followed by 18% in Shivamogga and 6.6% in Uttara Kannada (Figure 4).

Between 2014 and 2016, 66.7% of patients with cleft lip and 35.7% of patients with cleft lip and palate (Q37) received cheiloplasty between 3- 6 months of age (Figure 5). For the same period, 23.7 % of patients with cleft palate (Q35) and 28.6% of patients with cleft lip and palate (Q37) received palatoplasty between 12-18 months of age (figure 6).

Discussion

This study gives information on cleft patients visiting the multispecialty hospital in Karnataka from 2014 to 2016 which is cartographically represented based on case records. Thematic maps are used to represent intensity and cluster of cleft lip and palate patients and protect the confidentiality of the disease data. Implementation of GIS analysis may help establish their visualization of the disease and treatment programs with the health organization.

The characteristics of the patients were consistent with the previous studies in most areas.[8]

[-10] The study revealed female predominance in cleft palate cases. Most of the studies have reported female predominance, which can be due to the fusion of the palatine shelves in girls 1 week later than in boys. [11]

In contradiction, even gender distribution of patients with cleft lip was noted which may be due to an underpowered sample.

Previous studies [8,9,12] have shown that cleft lip most commonly occurs with cleft palate, contrary to the present study, where Cleft palate (Q35) is more predominant. In the pathogenesis of cleft lip and palate (Q37) variations in the genetics and environmental factors play a significant role. Consequently, relative proportions can vary in different studies.

Our GIS analysis revealed that the catchment area extended towards the borders of Karnataka over the years, however, the definite cause could not be attributed.

The geospatial distribution maps revealed, that most of the patients who got treatment from the multispecialty hospital lived close by. This could be due to the incidence of cleft lip/palate which was particularly high around the hospital. The distance and cost of commuting could have burdened patients who live further away from not seeking treatment.

The GIS analysis revealed only 23.7 % of patients with cleft palate (Q35) and 28.6% of patients with cleft lip and palate (Q37) received palatoplasty on time as per the hospital cleft care protocol. According to Agarwal K, a dearth in awareness, education, and socio-economic factors is the reason for the delay in seeking treatment in India.[13] Communication is one of the key elements for patient follow-up. The use of cellular phone-based follow-up was found to be effective in a developing country.

Geospatial analysis can help demarcate the high prevalence areas and also help determine the number of patients with unmet needs.[14] Public awareness programs and health service provision can be planned to the under accessed areas. Based on GIS results, the cleft care teams could be coordinated to unmet needs.

In some countries, GIS is already being used in the management of cleft lip-palate care. According to Tollefson et al, GIS software provided data for the assessment of primary needs, which is useful for direct contact with Zimbabwe's healthcare providers and prospective patients.[15]

According to a literature review conducted by Fradelos EC et al , GIS helps make predictions of certain services that are in demand at specific locations, as well as the exact location of specific medical equipment, which helps healthcare workers provide more efficient and faster services.[16] GIS makes policy planning and information analysis simpler to track the geographical locations of patients, health care providers, and services.

GIS can be a valuable resource in the current scenario for the management of the 21st century's major global pandemic. The GIS can aid in understanding the pandemic, its geographical influence on decision-making and everyday life, and its prediction of the disease growth.[17]

Limitations

The power of the study is less due to the short term follow up and small sample size. This can be addressed by including previous data and ongoing data to provide a unique database for future GIS analysis.

Nonresponse bias may have contributed to an unpredictable follow-up after cheiloplasty if the parents felt that dealing with cleft palate was less relevant.

Conclusion

The study revealed, that most of the patients who received treatment from/or contacted the hospital lived nearby. The Centre's treatment protocol for cleft lip/ palate was advised to patients/ caregivers including surgical procedures. GIS allows health mapping and analysis more

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efficiently than conventional approaches, as well as offering simple and convenient access to large volumes of data for healthcare professionals. The GIS data is useful in improving the communication between hospitals and the community by planning outreach programs, follow up on treatment, and thereby improve the care of cleft lip and palate individuals. Depending on the researcher's expertise, creativity, and ability to help its deliberation in the health sector management, the possibilities that can be explored are endless. Moreover, the sustainability and expansion of this study model GIS can play a major role in research and advocacy for better care and treatment of the selected population.

Ethical approval

The study was in accordance with the declaration of Helsinki and approved by institutional ethical committee (IEC: 217/2018)

Conflict of interest

There is no conflict of interest to declare

Acknowledgement

None

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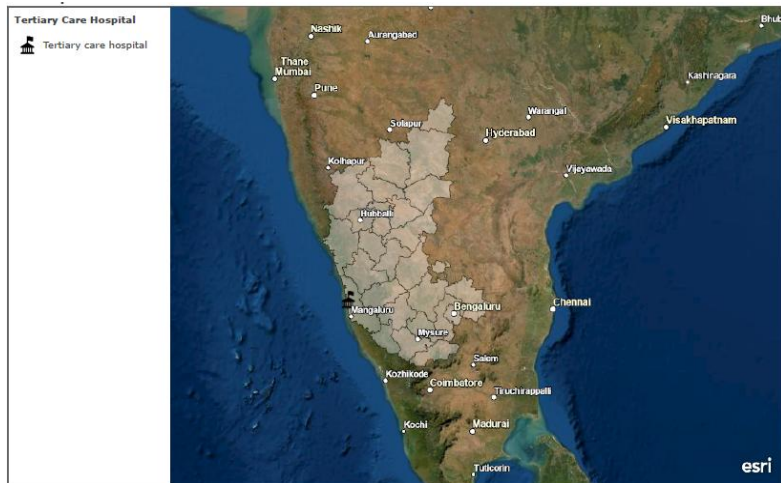
Figure 1

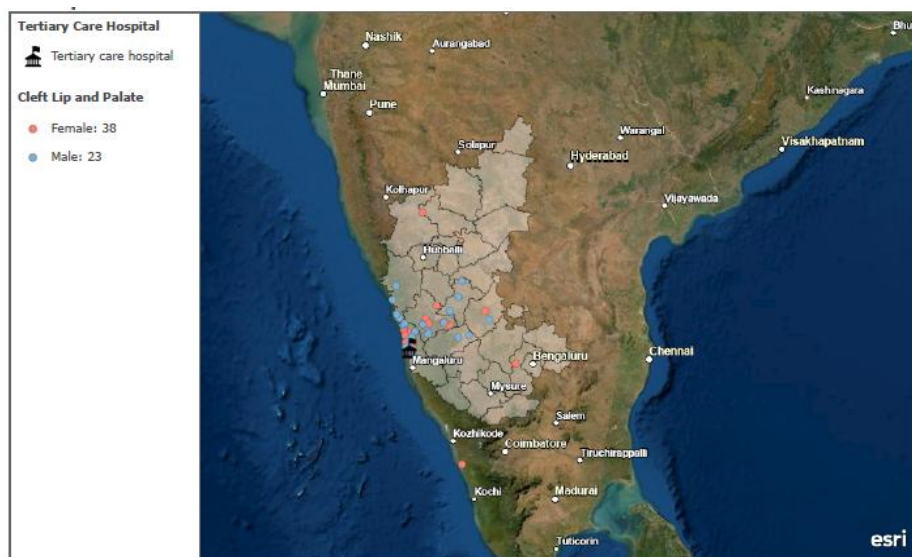Figure 1: Geographic and topographic map of Karnataka, India

Figure 2

Figure 2: Geographic gender distribution of all patients with cleft lip and/or cleft palate
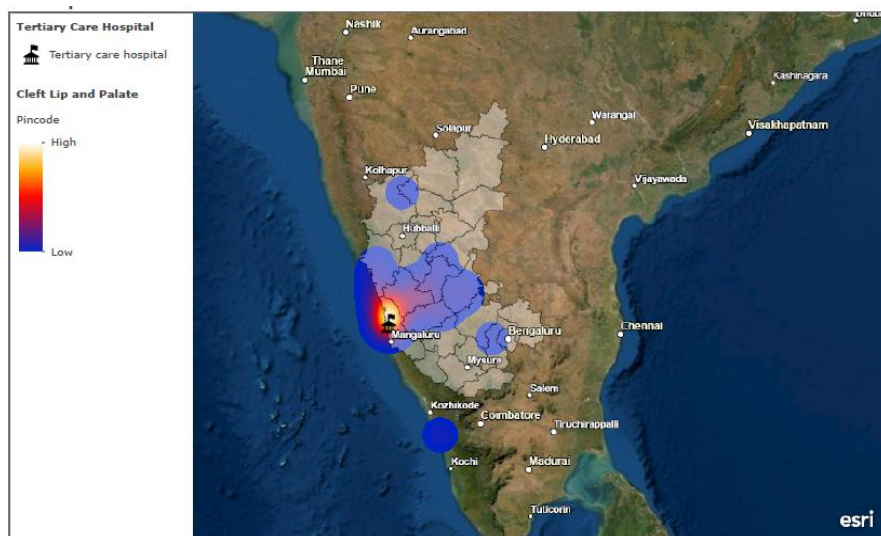
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Figure 3

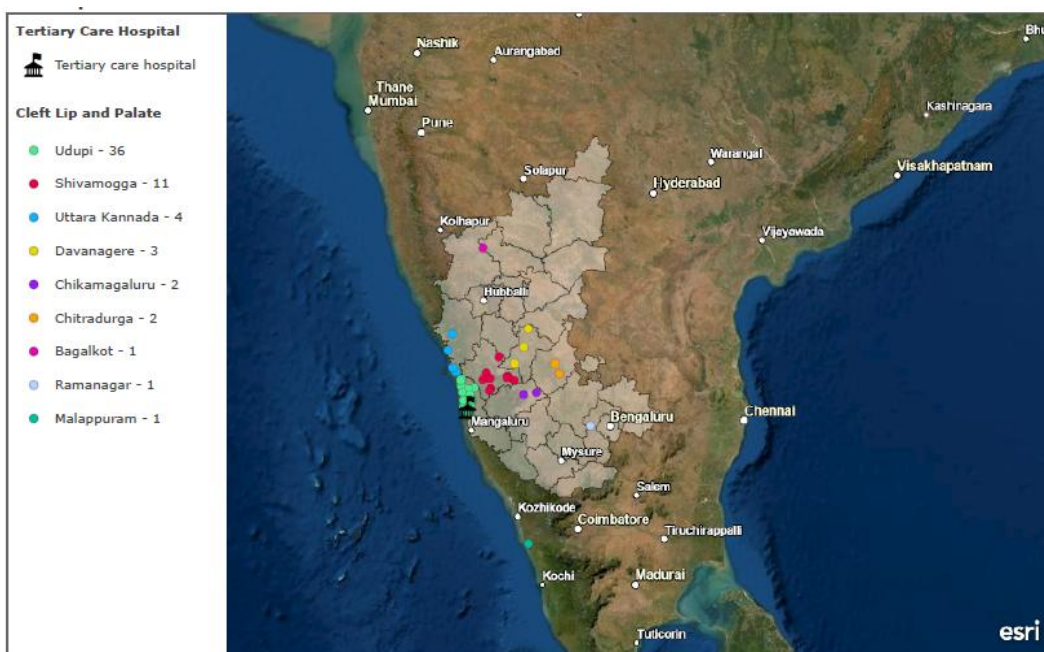Figure 3: Thematic map of intensity distribution of patients with cleft lip and/or cleft palate

Figure 4

Figure 4: Geospatial distribution of all patients of Cleft lip with or without palate visiting the

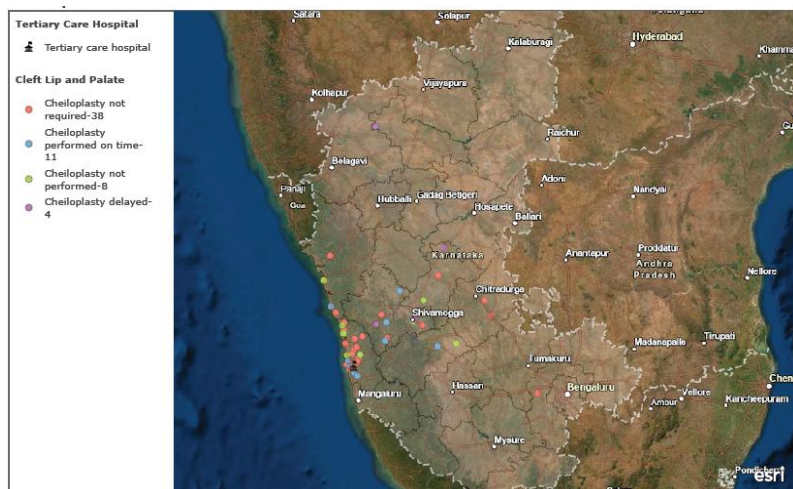Multispecialty Hospital in Karnataka from 2014 to 2016

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Figure 5

Figure 5: Geographic distribution of Cheiloplasty performed during 2014 and 2016
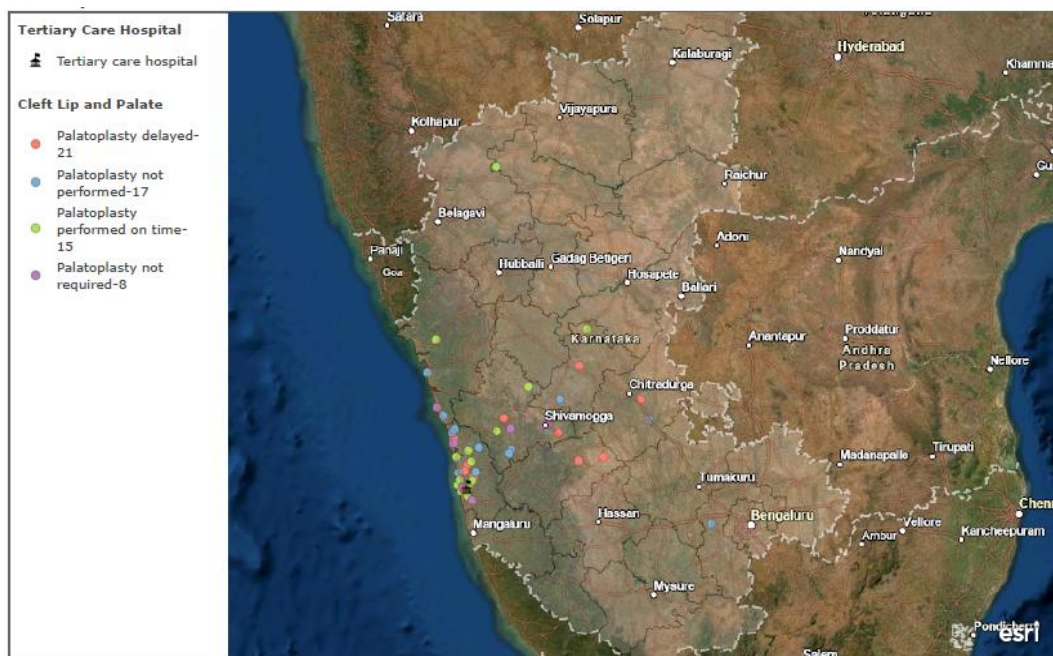
Figure 6

Figure 6: Geographic distribution of Palatoplasty performed during 2014 and 2016