The 'proto-Indian' population identified in the recent mtDNA studies posit an ancient southeast Asian migration that passed through India

Several independent evidences indicate Africa as the place of origin of modern man. Mitochondrial DNA (mtDNA) studies date the origin of anatomically modern man in Africa approximately around 200,000 years ago[1], and there is archaeological evidence for migration of modern man from Africa to the rest of the world about 100,000 years ago and the expansion of the non-African population around 65,000 years ago[2]. This expansion and the resultant migrations of modern man to inhabit major parts of the globe is of considerable interest because such an event would have preceded or have been closely associated with the origins of the three major world ethnic groups, the Orientals, the Caucasians and the Africans. Even though very distinct features are associated with each of the three ethnic groups, many intermediate populations have also evolved due to continuous gene flow among the above major groups. Gene flow due to secondary migrations could be expected to have diluted the ethnic features of the original inhabitants during population expansion. In some cases, mtDNA which is a single lineage molecule, could be used to trace the preexistent population, which would have got mixed with later migrants[3]. Identifying the original inhabitants may in turn help in understanding the history of migrations. There have been efforts to trace the actual routes followed by modern man while migrating from west Asia towards east. Geographically, like China, India is also located in the path of west to east migrations of modern man outside Africa. Thus the mtDNA studies of the Indian population are important with respect to global migrations of modern man.

The oldest evidence of Homo in India is the Narmada man, a *Homo sapiens* fossil dated 0.7 myr[4]. There is archaeological evidence for Homo about 600,000 years BP (before present) and for modern man about 40,000 years BP[5]. Linguistic evidence supports the suggestion that neolithic migrations of farmers brought the Dravidian language speakers from the Zagros region of Iran and Iraq and the Indo-European language speakers from Central Russia or Turkey[6,7].

Our study of mitochondrial DNA (mtDNA) polymorphisms, in 145 Indians, using the six classical restriction enzymes, (data for 45 are from an earlier study by Semino *et al.*[8]) includes samples from 14 Indian language groups identified as Indo-European and Dravidian language speakers[9]. Based on this study and considering linguistic evidence, we suggested that Indo-European language speaking and Dravidian language speaking Indians could perhaps be considered as two populations with affinities to Caucasians and may represent the two neolithic migrations.

In addition to a majority of Caucasian mtDNA types, we also found Asian mtDNA types in the sample we studied. Two Asian mtDNA types found in north and central Indians are shared with the Tharus of Nepal who are related to east Asians. Interestingly it has been suggested that the Tharu mtDNA perhaps originated from an Oriental mtDNA which is different from that of the more northern Asian population which migrated to the Pacific Islands and Siberia[10].

A separate study of the Indians[11] has also clearly demonstrated Asian admixture in the Indian population. 241 Indians from Punjab, Delhi and Andhra Pradesh have been included in this study which is based on identifying the Asian-specific $DdeI_{10,394}AluI_{10,397}$ (++) haplotype[12] in the Indian sample. An overwhelming presence of this Asian-specific mtDNA type in Indians has been demonstrated. The results of the high resolution study of 30 samples belonging to $DdeI_{10,394}AluI_{10,397}$ (++) haplotype[11] (Table 4) when compared to our RFLP study using the six classical enzymes (*HPa*I, *Bam*HI, *Hae*II, *Msp*I, *Ava*II, and *Hinc*II) showed that an overwhelming majority of the 30 Asian-specific types could be placed with the common mtDNA type or those shared with orientals (1, 6, and 28 in Figure 1 of Barnabas *et al.*[9]). Our study of the Indian sample for the presence of $DdeI_{10,394}AluI_{10,397}$ (++) haplotype (unpublished results) supports these observations.

Our RFLP study using the six enzymes had identified the ancient Asian mtDNA type (8–1) which has a common mutation in the *Hpa*I and *Hinc*II sites in Indo-European language speakers and a form which can be derived from this type was found in a Dravidian language speaker. Passarino *et al.*[11] have reported the same mtDNA type (8–1) in two individuals. Whereas, another mtDNA type (1–1–2–1–1–1), which can be derived from the ancient Asian mtDNA type and found at a higher frequency in the present day Southeast Asians[12], has been found only in one individual in the Indian sample[11]. Thus in the Indians the more ancient mtDNA type (8–1) is found at a higher frequency compared to the derived one (1–1–2–1–1–1). This is in contrast to the frequencies of these two types found among the Orientals where the derived one is more frequent. This observation suggests that the latter type would have originated and spread in Orientals who separated from 'proto-Indians'. Based on this we had also suggested the possibility of a migration from Africa to Asia that passed through the Indian subcontinent. Other studies[12] have supported an Asiatic migration through China and our suggestion does not contradict these studies. We would like to mention some more recently published evidence that gives credence to this suggestion about an ancient migration. An mtDNA sequence study has pointed out the possibility of the existence of a population in India before the first Caucasian migration reached India[2]. Mountain *et al.*[2] in their study of three Indian caste groups from Karnataka (southern India) suggested that their common ancestor may predate the Eurasian migration.

There is further support from yet another study[13] which suggests that there were two distinct migrations towards

east Asia and Oceania; one north of the Himalayas leading to China and Japan, while the other more southern. It is probable that the southern migration towards southeast Asia passed through India and is represented by the Palaeolithic cultural remains of modern man in India. The admixture between the Palaeolithic man and the agricultural migrations is seen in the above-mentioned studies including our own. However these findings do not rule out a more recent Asiatic admixture in the northeastern Indian population. Nevertheless, the mtDNA studies of the Indian population have identified the remnants of an ancient Indian population which would have spread throughout the subcontinent and got mixed with the later migrants. We would like to point out again that the available evidence indicates that the early population would have reached India as part of the first modern man migrations from the west towards the east.

1. Vigilant, L., Stoneking, M., Harpending, H., Hawkes, K. and Wilson, A. C., *Science*, 1991, **253**, 1503–1507.
2. Mountain, J. L., Hebert, J. M., Bhattacharya, S., Underhill, P. A., Ottolenghi, C., Gadgil, M. and Cavalli-Sforza, L. L., *Am. J. Hum. Genet.*, 1995, **56**, 979–992.
3. Horai, S. *et al.*, *Am. J. Hum. Genet.*, 1996, **59**, 579–590.
4. Kennedy, K. A. R., Sonakia, A., Chiment, J. and Verma, K. K., *Am. J. Phys. Anthropol.*, 1991, **86**, 475–496.
5. Misra, V. N., *Man Environ.*, 1989, **14**, 17–64.
6. Renfrew, C., *Sci. Am.*, 1989, **261**, 82–90.
7. Renfrew, C., *Sci. Am.*, 1994, **270**, 104–110.
8. Semino, O., Torroni, A., Scozzari, R., Brega, A. and Santachiara-Benerecetti, A. S., *Ann. Hum. Genet.*, 1991, **55**, 123–136.
9. Barnabas, S., Apte, R. V. and Suresh, C. G., *Ann. Hum. Genet.*, 1996, **60**, 409–422.
10. Passarino, G., Semino, O., Modiano, G. and Santachiara-Benerecetti, A. S., *Am. J. Hum. Genet.*, 1993, **53**, 609–618.
11. Passarino, G., Semino, O., Bernini, L. F. and Santachiara-Benerecetti, A. S., *Am. J. Hum. Genet.*, 1996, **59**, 927–934.
12. Ballinger, S. W., Schurr, T. G., Torroni, A., Gan, Y. Y., Hodge, J. A., Hassan, K., Chen, K. H. and Wallace, D. C., *Genetics*, 1992, **130**, 139–152.
13. Poloni, E. S., Excoffier, L., Mountain, J. L., Langaney, A. and Cavalli-Sforza, L. L., *Ann. Hum. Genet.*, 1995, **54**, 43–61.

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