An Ode to Music:
Chaos Theory, Meridians and Melakarthas

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Abstract:
It is well known that the variations in frequencies (Swaras) and timbre (tone) form melody (Raga), the key aspect leading to all kinds of music experience. The pinnacle of exploring the frequencies within an octave is the Melakartha system of Carnatic Music, forming the motivation of the present work. A time domain waveform of the Swara is used to form an iterative map explaining the evolution and behavior of the Raga, and thus music experience. The presence of sensitivity, or chaotic behavior is seen and studied using phase portraits, maximal Lyapunov Exponents and Distance Plots. Following this, the basics of Meridian based healing in Traditional Chinese Medicine are explored, and by formulating a procedure to compute the "Deviance" of a Raga, the 72 Melakartha Ragas are mapped to the 72 Meridians in the Human Body. It is opined that this article takes the first step towards a series of research developments culminating in an era of "Holistic Healthcare and Personal/Personnel Management using Music".

Keywords: Music, Melakartha Ragas, Chaos Theory, Iterative Map, Meridians, TCM

1. Introduction:
The history of music has been for the most part as rich as music itself. Around the world, music has been used for various purposes including but not limited to entertainment, spiritual progress, holy communion, recitation, lullabies, courtship and healthcare [1-14]. From a physics perspective, this is only appropriate, since music pertains to one of the primordial forms of energy – sound [15-18].

It is a well-known and established fact that most of the experience from music comes by virtue of its melody, composed of scales and notes, where notes, also called Swaras are frequencies or bands of frequencies [19-23]. Fundamental to this idea is the concept of octave, which is seen as the frequency space between a frequency and its double. That is, the frequencies f of a Swara S, in successive octaves n and $n-1$ are related by $f(S_n) = 2f(S_{n-1})$.

Across varied cultures, it is established over time that within an octave, the number of discernible frequency bands is 7. This is the genesis of the concept of notes, or Swaras. However, frequency bands have been resolved into smaller bands, or as individual frequencies as well, which gives rise to the types of Swaras such as Major (Theevra) and Minor (Komal) [19-23].

While most of the western music is based on the Chromatic Scale, containing 12 notes as "tones" and "semitones" in an octave, or any of its subsets, Arabic Music in particular uses 24 notes, including "quartertones" as well [23-26].

Arguably though, no system of music has explored the frequencies of an octave as much as Indian Music, for reasons as explained below [27].

1. Though on first glance, the Indian music has settled for 12 Swarasthanas in an octave, this is far different from the Western Music, as the 12 notes are not absolute frequencies. It is a frequency ratio based system where the 12 notes are chosen in relation to the fundamental C (Shadjam or "Sa"), while the absolute frequency of Sa itself is left to the choice of the performer.
2. The concept of Gamakas, or 'oscillations' enable a form of ornamentation to notes, in the sense that notes are allowed to oscillate in the vicinity of the corresponding ratio. Ranging from simple ascent and descent to more complex forms, atleast ten varieties of Gamakas have been enumerated in treatises (Dasha Gamaka), and the use of these depends heavily on the context, such as the Raga being performed, its characteristics and so on.
3. Since the absolute frequencies of Swaras are not fixed in Indian music, it is often seen that different combinations of Swaras effect a slight shift on the frequencies of neighbouring Swaras. Thus, if a Komal Swara is replaced with its Theevra counterpart in a Raga, not just that Swara, but most other Swaras will undergo a frequency shift, albeit very slight.

Using these concepts, the pinnacle of frequency exploration in Indian Music has to be the Melakartha Raga system of Carnatic Music. Conceived as a simple exercise in mathematical permutations and combinations between various varieties of Swaras, the fundamental premise is that these Ragas arise from scales that have exactly seven notes in their ascent and seven in their descent, each seven containing exactly one type (Komal or Theevra) of the 7 Swaras, and the type being the same in both ascent and descent. An interesting concept introduced in the Melakartha System is the concept of Vivaadhis, where both varieties of a Swara are used, one of which takes the role of a neighboring Swara.

Though the possibilities of such permutations and combinations easily cross a hundred, a preliminary requirement that the frequency progression through Sa, Ri, Ga, Ma, Pa, Dha and Ni in the ascent as well as its reverse in the descent be unidirectional has ensured that the number of Melakartha Ragas is an all inclusive 72, of which 40 have atleast one Vivaadhi Swara [27].

In this article, the system of Melakartha Ragas are explored rom two perspectives. First, the interaction and interplay between the frequencies constituting a Melakartha Raga is seen as the embodiment of a well-known physics concept – Chaos Theory, and this is done by obtaining a Difference Equation describing the evolution of Music, as well as plotting Distance Maps. The second perspective stems from the mention in ancient treatises that the 72 Melakartha Ragas map to and influence the 72 Nadis, or energy channels, known in Traditional Chinese Medicine as Meridians. We begin with the fundamental premise that Kharaharapriya, the 22nd Mela Raga is the Raga of Vedic music, attributed to the highest of the three Gunas or "behaviors" (Sattva). From this concept, we compute how much each Mela Raga deviates from this configuration, termed "Deviance", and using some fundamental mappings between music and Chinese Terminology, provide and list a mapping of the 72 Melakartha Ragas with the 72 Meridians.

It is opined that the studies elaborated upon in this paper, both from a physical and astronomical perspective will usher in a music-dominated era, characterized by the almost no side-effect music based healthcare and personal/personnel management using music.

2. Deriving the Waveform of a Raga in Time Domain

It is a well-known fact that the fundamental properties of sound are dynamics (loudness), pitch (frequency) and timbre (tone). While the frequencies indeed correspond to the Swaras, the choice of musical instrument (including vocal) affect the timbre [15]. From a signal processing perspective, Swaras merely determine the central frequencies of each of the 7 bands, whereas the timbre determines the amount of harmonic content around the central frequencies, and differs from instrument to instrument. Various attempts have been made at studying the spectral and timbre characteristics of various musical instruments and formulating mathematical expressions to synthesize such sounds, of which the most interesting result yields empirically the following expression as the output of a flute, the instrument with least number of harmonics, for a Swara *S* with centre frequency f_s [28-34]:

$$S(t) = \frac{1}{2.7490}\sum_{i=1}^{4} A_i \cos(2\pi i f_s t) \qquad (1)$$

where $A_1=2.54$, $A_2=0.245$, $A_3=0.009$ and $A_4=0.00001$.

The above equation describes the time domain waveform obtained for the flute output of a single Swara. However, a typical Raga has 12 possible Swaras, with Sa and Pa having one variety each, and Ri, Ga, Ma, Da and Ni having two varieties each. Of these 12, any Raga only allows a certain subset, and certain Ragas also have a proportion distribution among Swaras. For instance, Shankarabharanam, the 29th Melakartha Raga often associated with the Major Scale of Western Music has Sa, R2, G2, M1, Pa, D2 and N2, all in equal proportions, while Mohanam, a "child" Raga has Sa, R2, G2, Pa and D2. A Raga such as Kedhaaram, a "child" of Shankarabharanam, has this structure – Sa M1 G2 M1 Pa N2 – Sa N2 Pa M1 G2 R2.

A convenient method to express these details is the Composition Matrix *M*. This matrix is formed by the computing the number of non-zero Swara types the Raga has, and expressing each Swara as a relative proportion of that sum. The composition matrix is a 1x12 1 Dimensional Row Vector with the following structure:

$$M = [Sa\ R1\ R2\ G1\ G2\ M1\ M2\ Pa\ D1\ D2\ N1\ N2] \qquad (2)$$

The Composition Matrices of Shankarabharanam, Mohanam and Kedhaaram are respectively as follows:

$$M_{Shankarabharanam} = [1\ 0\ 1\ 0\ 1\ 1\ 0\ 1\ 0\ 1\ 0\ 1] \qquad (2a)$$

$$M_{Mohanam} = [1\ 0\ 1\ 0\ 1\ 0\ 0\ 1\ 0\ 1\ 0\ 0] \qquad (2b)$$

$$M_{Kedhaaram} = [0.17\ 0.0\ 0.08\ 0.0\ 0.17\ 0.25\ 0.0\ 0.17\ 0.0\ 0.0\ 0.0\ 0.17] \qquad (2c)$$

The Swara value for each Swara in the Composition Matrix is taken as a coefficient (weight) for equation 1 of that corresponding Swara. By forming 12 such equations for all the Swaras, and adding them up, the "experience equation" of a "Raga", yielding the Raga Waveform *R(t)* is obtained as follows:

$$R(t) = \sum_{j=1}^{12} \frac{M(j)}{2.4790} \sum_{i=1}^{4} A_i \cos(2\pi i\, f_s(j) t) \qquad (3)$$

In this equation, the term $f_s(j)$ refers to the central frequencies of the 12 Swaras, represented as a 1D vector, similar to *M*, as follows:

$$f_s = f_0[1.00\ 1.06\ 1.13\ 1.18\ 1.25\ 1.33\ 1.42\ 1.50\ 1.59\ 1.67\ 1.78\ 1.89] \quad (4)$$

The term f_0 is the fundamental frequency of Sa, left to the choice of the performer. All calculations in the present article use a value of 100Hz for f_0, a mathematically convenient value corresponding to the voice frequency of a typical adult male. However, as mentioned earlier, it is the ratio and not absolute frequency that contributes to the experience of Indian Music.

3. Chaotic Characterization of the Raga

From the time domain equation of the Raga given in Equation 3, one obtains the time derivative *dR(t)/dt* as follows:

$$\frac{d\,R(t)}{dt} = -\sum_{j=1}^{12} \frac{M(j) f_s(j)}{2.4790} \sum_{i=1}^{4} 2\pi\, i\, A_i \sin(2\pi i\, f_s(j) t) \qquad (5)$$

Using this, we rewrite the derivative *dR(t)/dt* as a difference term $R_n - R_{n-1}$, and discretize the entire equation to obtain the following iterative function, termed the "Music Iterative Map".

$$R_n = R_{n-1} - \sum_{j=1}^{12} \frac{M(j) f_s(j)}{2.4790} \sum_{i=1}^{4} 2\pi\, i\, A_i \sin(2\pi i\, f_s(j) n) \qquad (6)$$

Equation 6 is the final equation depicting the evolution and behavior of the Raga equation.

It is seen from equation 6 that the behavior of the Raga waveform and subsequently the experience of music heavily depends on the product term $P=M(j)f_s(j)$, which gives the relative proportion of each frequency in the overall waveform.

Different Ragas with different values for *P* show widely diverse behavior due to this property. A slight change in the value of *M(j)* or alternatively *P* will cause a drastic change in the evolution of *R*. This property is well-known in physics; it is sensitive dependence on Initial Conditions, the starting point in "Chaos Theory", with *P* playing the role of initial condition or "control parameter".

The "Sensitive Dependence on Initial Conditions" is explained more popularly as the "Butterfly Effect", which states that a Butterfly flapping its wings in Texas will in due course, cause a Tornado in Brazil [35-

39]. Furthermore, the property that the initial events are carried over to subsequent events amplified implies that chaos contains “memory”.

Chaos is essentially deterministic. This means that if one knows the initial conditions, one can easily find out the output of a chaotic system at any point in time [35-39]. But since the behavior is so fluctuating and it is almost always impossible to know all initial conditions, it appears like as if the chaos looks random, which is a clearly misleading appearance.

The starting step in most cases of chaotic characterization is the definition of iterative map, which in this article is defined by Equation 6. Following this, various plots are used for the visualization of chaotic map, like for instance the Bifurcation Plot, which describes how values of *R* vary with *P* [35-39]. However, since *P* is a matrix in itself, this leads to multiple control parameters manipulating the output, corresponding to the case of a multidimensional chaotic system [35-39].

One useful plot to understand and confirm the presence of chaotic behavior is the phase portrait, which plots the derivative of R, given in Equation 5, as a function of R, given in Equation 3. This plot describes the stability aspects of the system behavior and points of stability around which the system revolves, while also assessing various related parameters such as sensitivity and ergodicity [35-39].

As an example, the time domain waveform R(t) and corresponding phase portrait of Shankarabharanam are shown in Fig. 1 and Fig. 2.

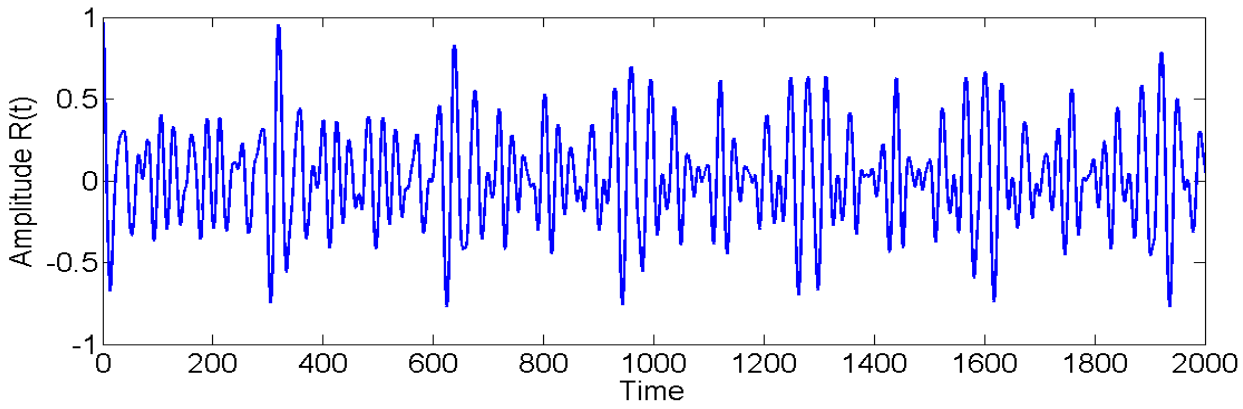

Figure 1 Time Domain waveform R(t) of Shankarabharanam

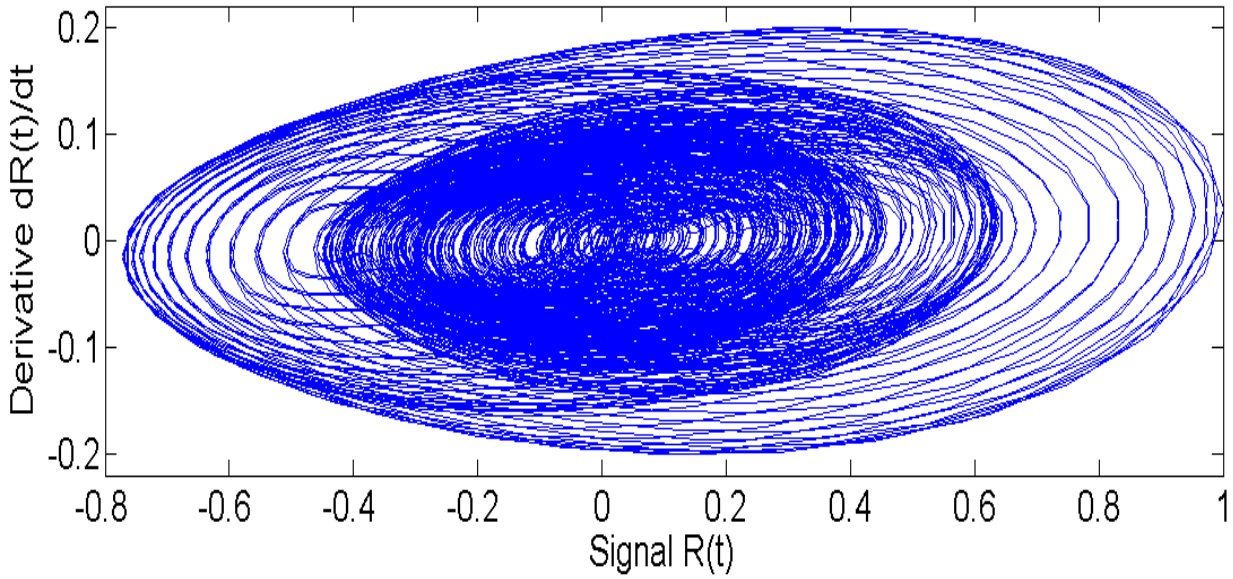

Figure 2 Phase Portrait of Shankarabharanam. The ornamental pattern seen is a typical signature of chaotic systems

A quantitative characterization technique ideally used to characterize the sensitive dependence of a system on initial conditions is the maximal Lyapunov Exponent, denoted as the MLE where a positive value of MLE asserts the presence of chaos [40,41]. Methods such as the Rosenstein's Algorithm exist to determine the Lyapunov Exponent from the time series *R(t)* [40,41]. Specifically, an evolution time Δt is defined and the *ith* sample of the divergence *d* for the *jth* trajectory is expressed as a function of λ in the following manner, where the λ*'s* denote the Lyapunov Exponents and C_j denote normalization constants [40,41]:

$$d_j(i) = C_j e^{\lambda_i (i\Delta t)} \qquad (7)$$

The MLE then is the largest of the obtained λ_i's, and is an indicator of the presence of chaos. For Shankarabharanam, an MLE value of 5.01 is obtained, confirming its chaotic nature.

Perhaps the most ideal method of characterizing and studying the chaotic nature in a multidimensional system such as music is the Distance Plot.

The main premise in the concept of distance plot is that most natural processes including music possess recurrent behavior in the form of periodicities and irregular cyclicities. Here, a recurrence is defined as a condition where states in the system are arbitrarily close after some time of divergence [42-45].

On this concept, the distance plot (DP) is defined as follows: For a discrete signal with *N* samples denoted by *R(n)*, *n<=N*, the distance between the *ith* and *jth* point *D(i,j)* is given by [42-45]

$$D(i,j) = \|R(i) - R(j)\| \qquad (8)$$

The collection of all the distance points *D(i,j)* for all *i,j<N* form the Distance Matrix *D*, a plot of which is termed the Distance Plot (DP), usually plotted in black and white by setting a threshold level *T*. It has

been shown that certain dynamical invariants such as the Correlation Dimension, Kolmogorov Entropy and Mutual Information can be derived from DPs [42-45]. The key advantage of distance plots is that these plots provide useful information about the chaotic nature even for short term and non-stationary data [42-45].

As an example, the DP of Shankarabharanam is given in Fig. 3.

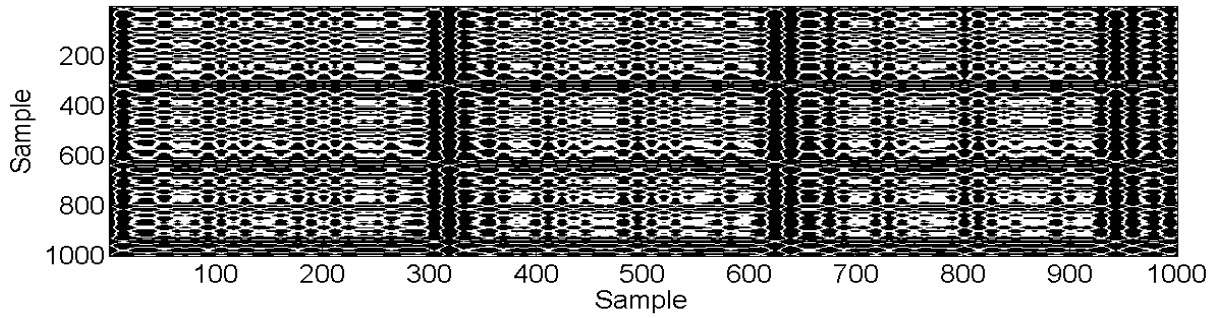

Figure 3 The Distance Plot of Shankarabharanam

The DP clearly shows interesting patterns of grouping, branching, isolations and periodicities, which when studied in detail would reveal vital details about the nature of chaos in Shankarabharanam Raga.

The Appendix Section of this article illustrates the DPs of all the 72 Melakartha Ragas.

4. Melakarthas and Meridians

Perhaps the most direct application of studying the mechanics of music is music therapy, to heal or alleviate various diseases and ailments, physical and mental [46-48]. The 72 Melakartha Ragas have been associated with the 72 Nadis of traditional Indian Medicine, where Nadis are seen as channels and pathways of energy flow in the human body. This Nadi concept has directly or indirectly been adopted into the Traditional Chinese Medicine (TCM) system as the 72 Meridians, and part of the objective of this article is to provide a mapping between the 72 Melakarthas and 72 Meridians [49-50].

In the TCM, the life Energy is viewed as “Qi”, and meridians are pathways for the Qi to flow. The 72 Meridians are classified into five groups as follows [49-50]:

1. 12 Primary Meridians, representing and associated with 12 vital organs such as lung, heart, stomach, spleen, liver etc. and themselves classified into 6 ‘Hand’ Meridians and 6 ‘Foot’ Meridians. In each category, there are 3 “Yin” Meridians (Major, Minor and Absolute) and 3 “Yang” Meridians (Lesser, Greater and Bright).
2. 12 Divergent Meridians, derived and branched from the main meridians to other organs.
3. 12 Sinew Meridians, derived from primary meridians and associated with corresponding muscular and skeletal regions.
4. 12 Cutaneous Meridians, derived from primary meridians and associated with corresponding regions in the skin.
5. 8 Extraordinary Meridians, which serve as key pathways for the “Qi” across the length and breadth of the body.

6. 16 Collateral Meridians, 12 of them derived from main meridians and 4 from extraordinary meridians, and all of them pertaining to interconnections between other meridians and capillary tubes.

A simplified illustration of the 12 Primary Meridians and 8 Extraordinary Meridians are shown in Fig. 4 [49-50].

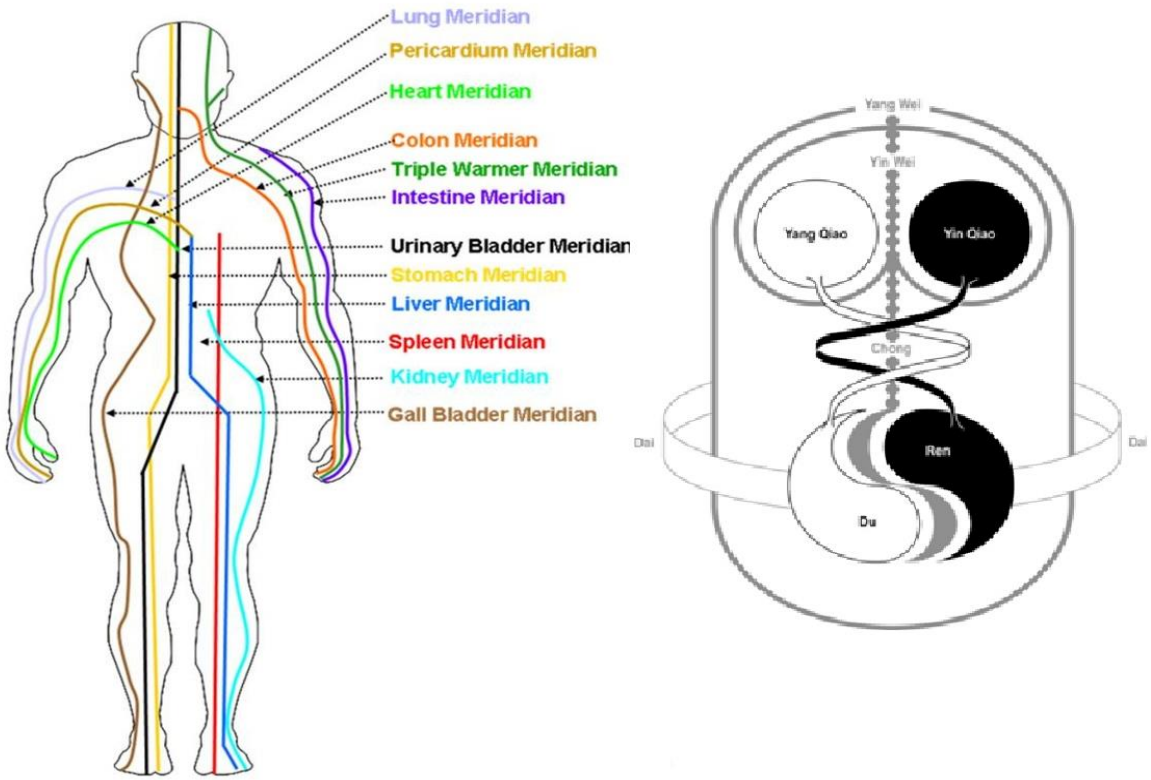

Figure 4 Simplified Illustrations of the Primary and Extraordinary Meridians

The first step in the mapping of Melakarthas to Meridians is knowledge of the fact that the 22nd Melakartha Raga Kharaharapriya is the Raga of Choice in Sama Veda Recitations owing to the superior Sattva Guna (Characteristics) and positive vibrations that the Raga reverberates with. Even in recent times, research has proven that mere chanting and reciting of Sama Veda without even understanding the meaning has shown to cause significant lowering of heart rate, skin conductance and EEG frequencies, all of them relaxing effects typically obtained using meditation and Yoga [51-55].

Thus, the base for the mapping is Kharaharapriya, which is a Sattvic purely positive vibration oriented Raga, not possessing overly motivational (Rajas) or demotivational (Tamas) Guna, and thus will be the base for calibrating other Melakartha Ragas.

The calibration is carried out by calculating each Raga's deviation from the Kharaharapriya Structure. Specifically, Theevra Swaras induce Rajasa Guna whereas Komal Swaras induce Tamasa Guna.

In the Meridian System, it is known that the Conception Vessel or "Du" Meridian is seen as the most important of all meridians, running through the central spine of the body, and corresponding with the most important and Sattvic Sushumna Nadi. Thus, this meridian is associated with the Kharaharapriya Raga.

The Composition Matrix M of Kharaharapriya is as follows:

$$M_{Kharaharapriya} = [1\ 0\ 1\ 1\ 0\ 1\ 0\ 1\ 0\ 1\ 1\ 0] \qquad (9)$$

It is seen that this Raga has 3 Theevra Swaras (R2, M1 and D2) and 2 Komal Swaras (G1 and N1). Now, any Raga with more Theevra Swaras than this would be Rajasic whereas any Raga with more Komal Swaras would be Tamasic. In order to compute that, a "Deviance Matrix" *DM* is obtained as follows:

$$DM = [0\ -1\ 0\ 0\ 1\ 0\ -1\ 0\ -1\ 0\ 0\ 1] \qquad (10)$$

This matrix is obtained by assigning 1 to Swaras more Theevra than Kharaharapriya (G2 and N2), -1 to Swaras more Komal than Kharaharapriya (R1, M2 and D1) and 0 to Swaras that Kharaharapriya possesses (Sa, R2, G1, M1, Pa, D2, N1).

By multiplying this matrix with the composition matrix *M* of a given Raga, and summing up the values, one obtains the "Deviance" of that given Raga, given by *D*. Thus, for Shankarabharanam, using Equations 2a and 10, we get

$$D_{Shankarabharanam} = Sum[0\ 0\ 0\ 0\ 1\ 0\ 0\ 0\ 0\ 0\ 0\ 1] = 2 \qquad (11)$$

On account of a positive *D* value, Shankarabharanam is classified as a Rajasic Raga.

By the very definitions of Yin and Yang nature, it is known that Yin and Yang correspond to Tamasic and Rajasic Guna respectively.

In order to map the 72 Ragas with the 72 Meridians, the Hamming weights of various meridians are taken. This is done by calculating the distance between each point in a meridian and its corresponding counterpart in the Du Meridian, and summing all the distances thus obtained. These Hamming weights are mapped onto the product of Deviance *D* and Lyapunov Exponent MLE using a rank based sorting strategy.

The Appendix tabulates the 72 Melakartha Ragas, their MLE values and the corresponding meridians and associated healing properties.

5. Conclusion

The concept of Melakarthas has been explored in two perspectives. First, by using a time domain equation of a Swara's waveform, and by formulating the Composition Matrix, an iterative map depicting the chaotic behavior and evolution of a Raga is investigated. The chaotic nature is studied using tools such as the Phase Portrait, Maximal Lyapunov Exponent and the Distance Plot. After taking a glimpse of the Meridian System of Traditional Chinese Medicine, the procedure to compute the Deviance of a Raga, and hence map the 72 Melakarthas to the 72 Meridians is presented.

By looking deep at the physical aspects of a Raga, the presence of sensitive and chaotic behavior has been discovered for the first time, and by introducing a mapping to the Meridian system, the concept of Melakarthas has been brought closer to a scientific approach towards music therapy. This article thus forms the first step towards a series of investigations and discoveries that lead to "Holistic Healthcare and Personal/Personnel Management using Music".

Acknowledgements:

Sai Venkatesh and Gomathi dedicate this article and the results obtained to Late Shri. Koteeswara Iyer, the first composer to compose full songs in all the 72 Melakartha Ragas, and Late Shri. S. Rajam, who single-handedly gave new life and popularized Iyer's songs, and from whom the authors trace their musical lineage.

Appendix

In this section, the distance plots computed using Equation 8 and Deviance computed using Equation 10 are presented for all the 72 Melakartha Ragas. The plots are arranged using the Chakra System, where all the 72 Melakarthas are grouped into 12 Chakras of 6 Ragas each, each Chakra having one Ri-Ga configuration with 6 different Dha-Ni configurations. The Ragas of the first 6 Chakras are parallel to the respective Ragas in the next 6 Chakras, with each parallel pair, such as Mela 1 and Mela 37, or Mela 8 and Mela 44 only differing in the type of Ma. Thus each page contains the distance plots of a Chakra and its parallel Chakra, enabling easy comparison of closely related Melakartha Ragas. It is seen that the distance plots of Ragas differing even by one Swara are drastically different, highlighting the sensitivity and chaotic properties of Music, as explained earlier.

Following this, a table of the 72 Melakarthas with their corresponding MLE values and associated meridians and healing properties is presented. The Melas are arranged numerically from 1 to 72.

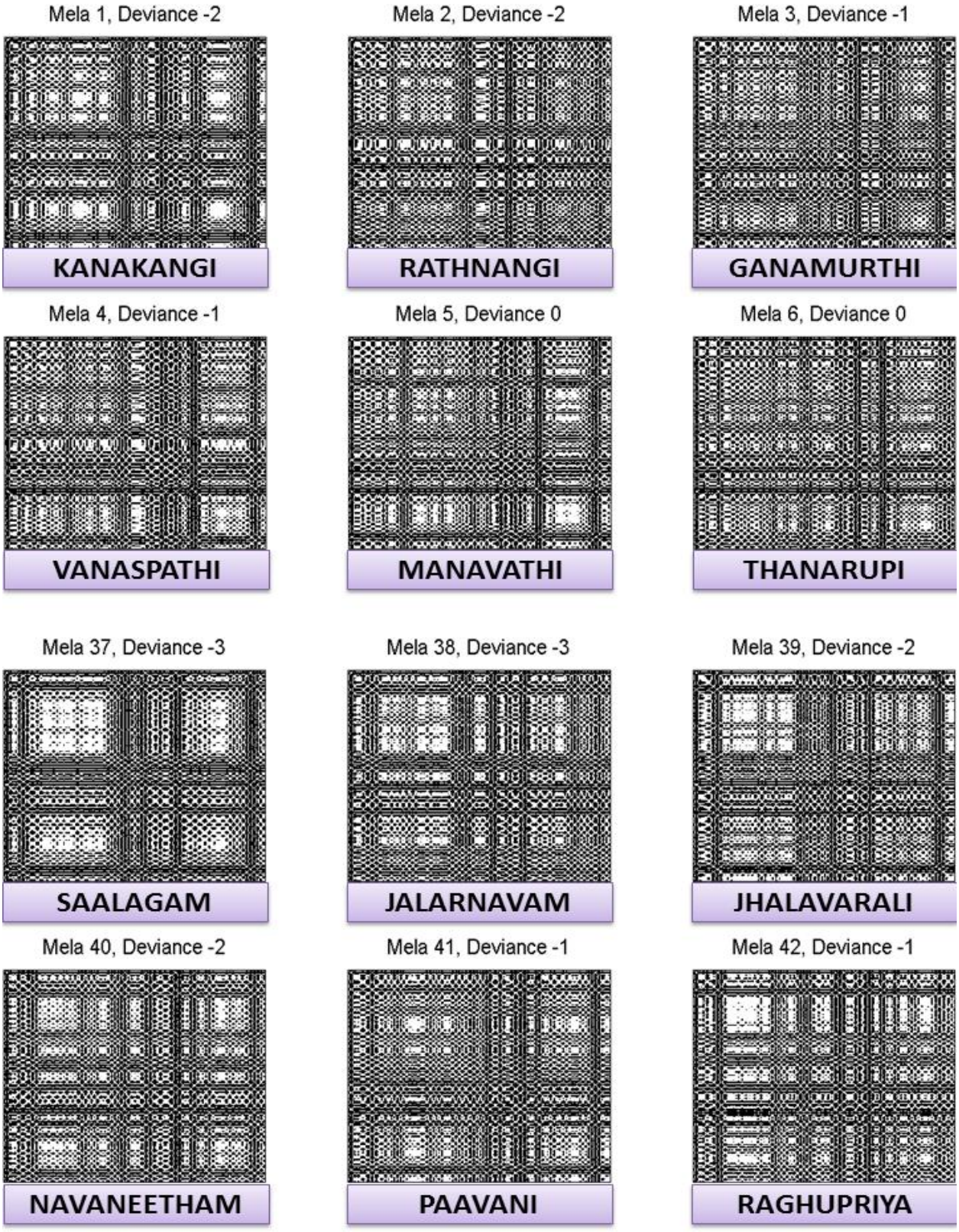

Figure 5 Distance Plots and Deviances for Chakras 1 and 7

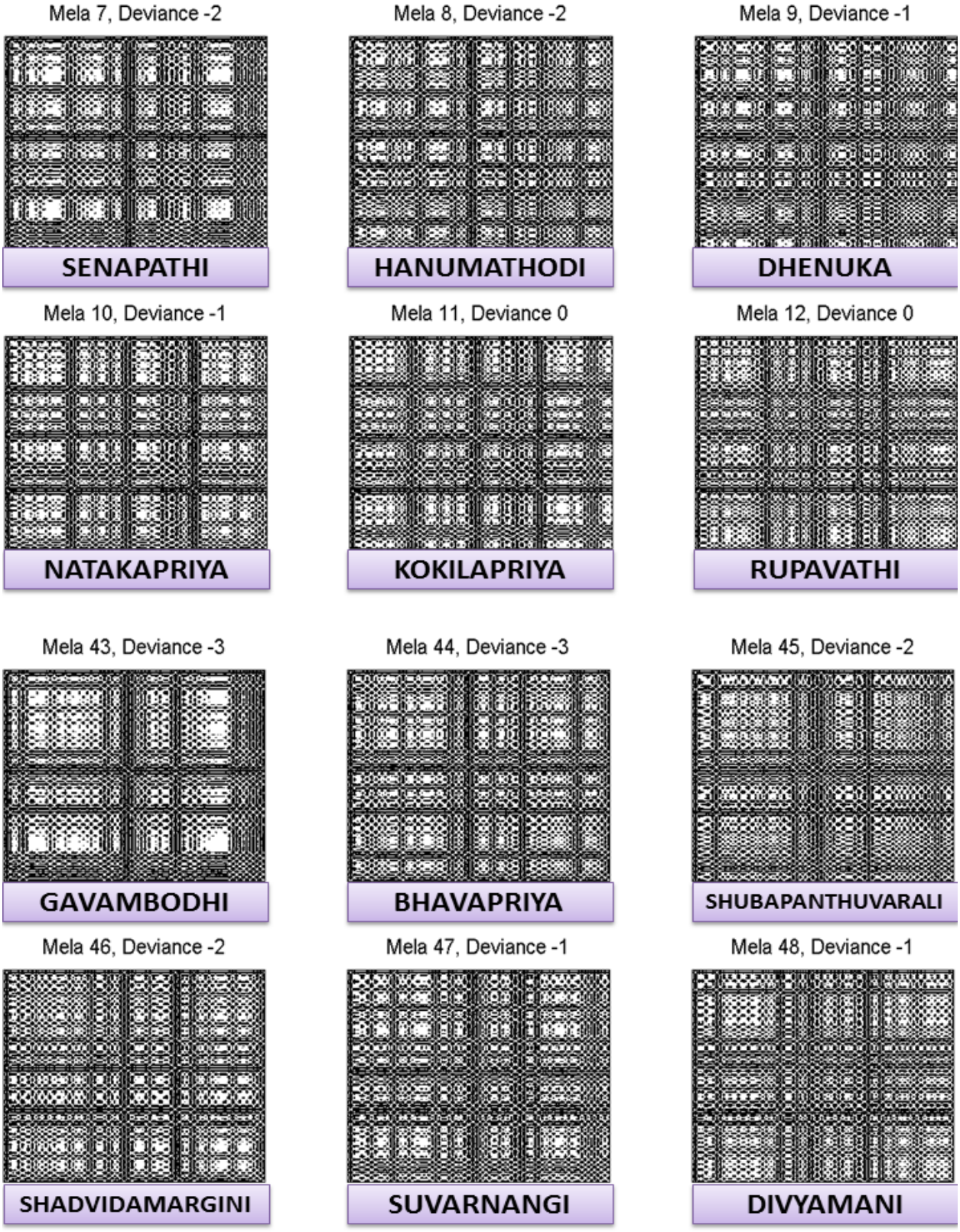

Figure 6 Distance Plots and Deviances for Chakras 2 and 8

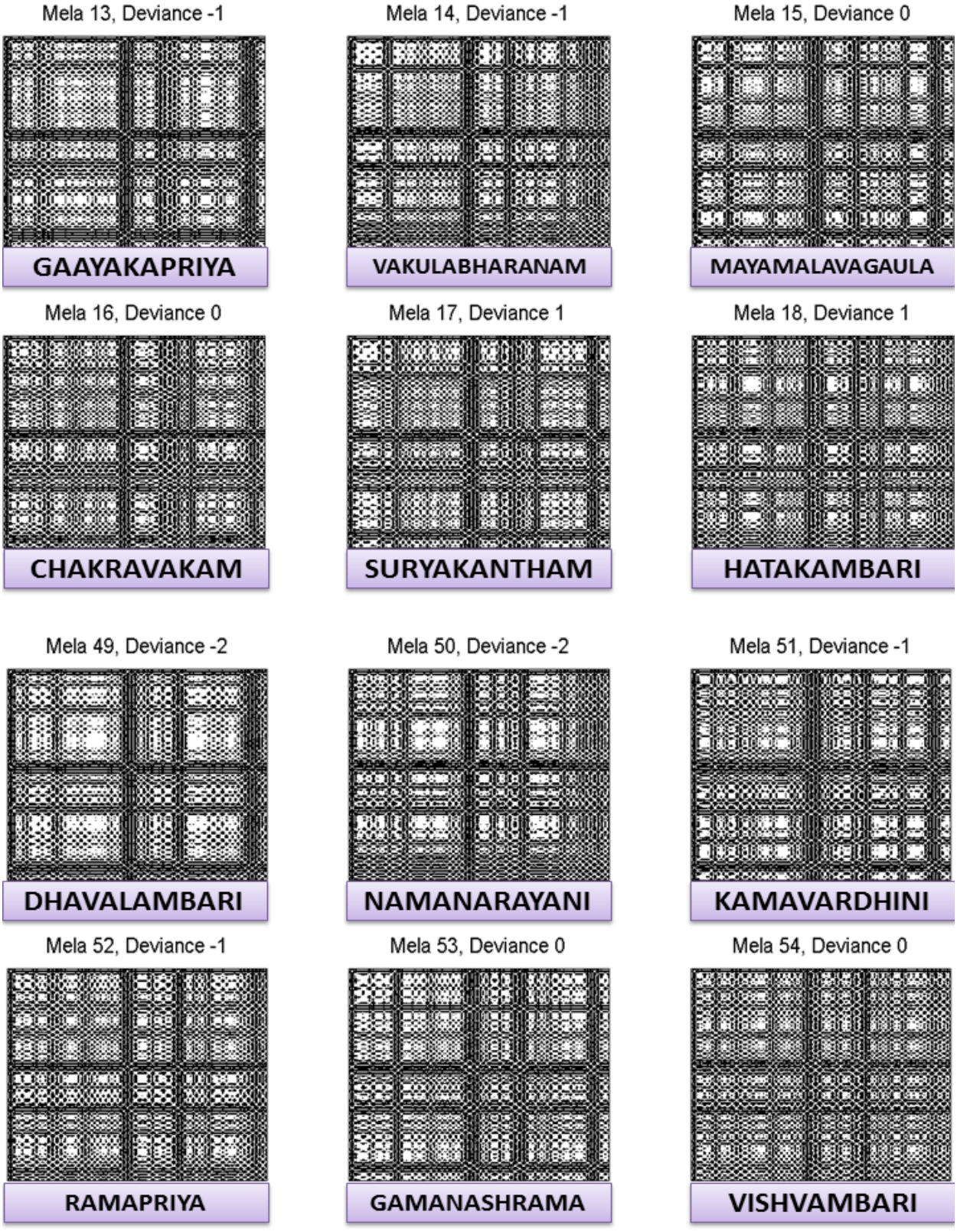

Figure 7 Distance Plots and Deviances for Chakras 3 and 9

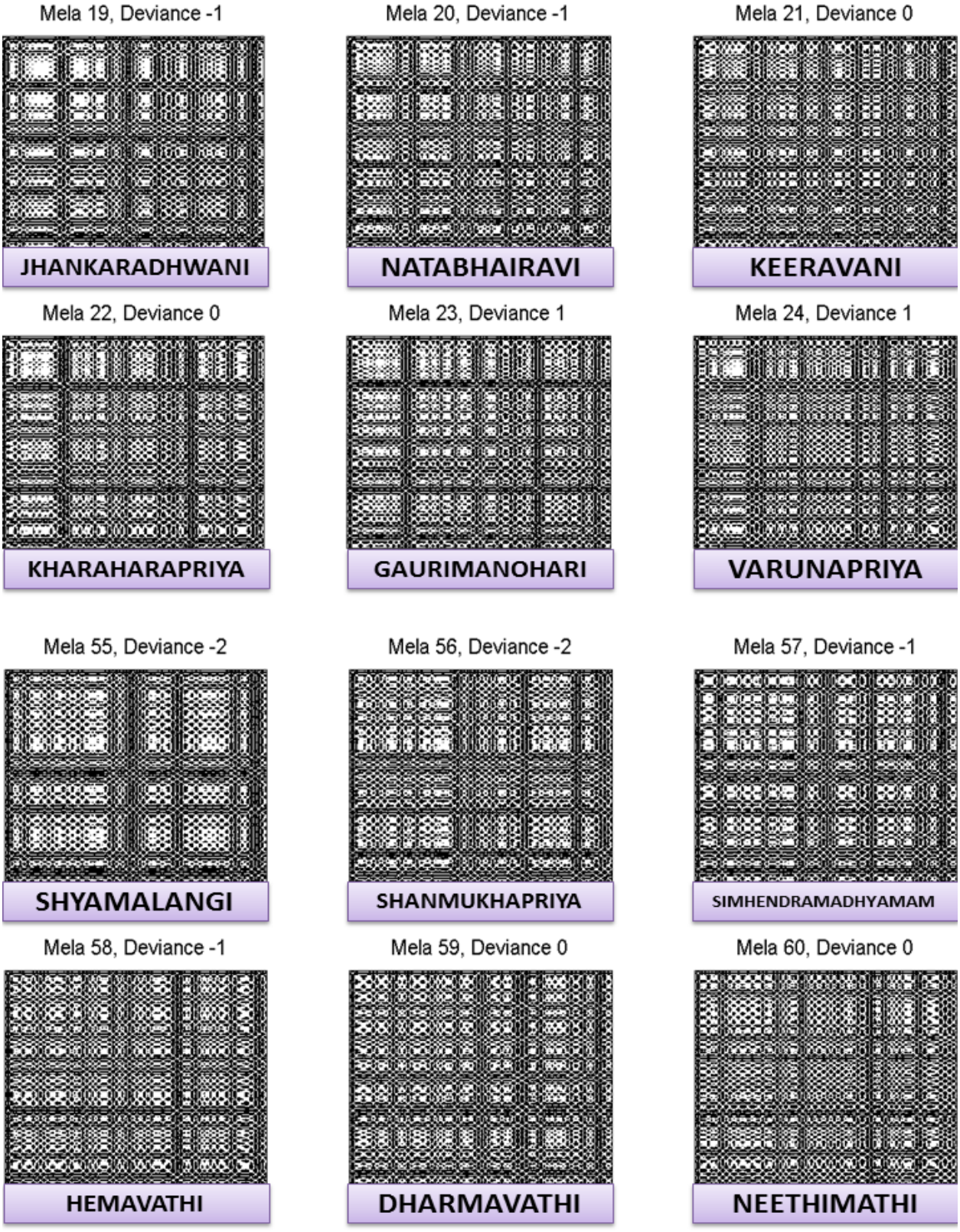

Figure 8 Distance Plots and Deviances for Chakras 4 and 10

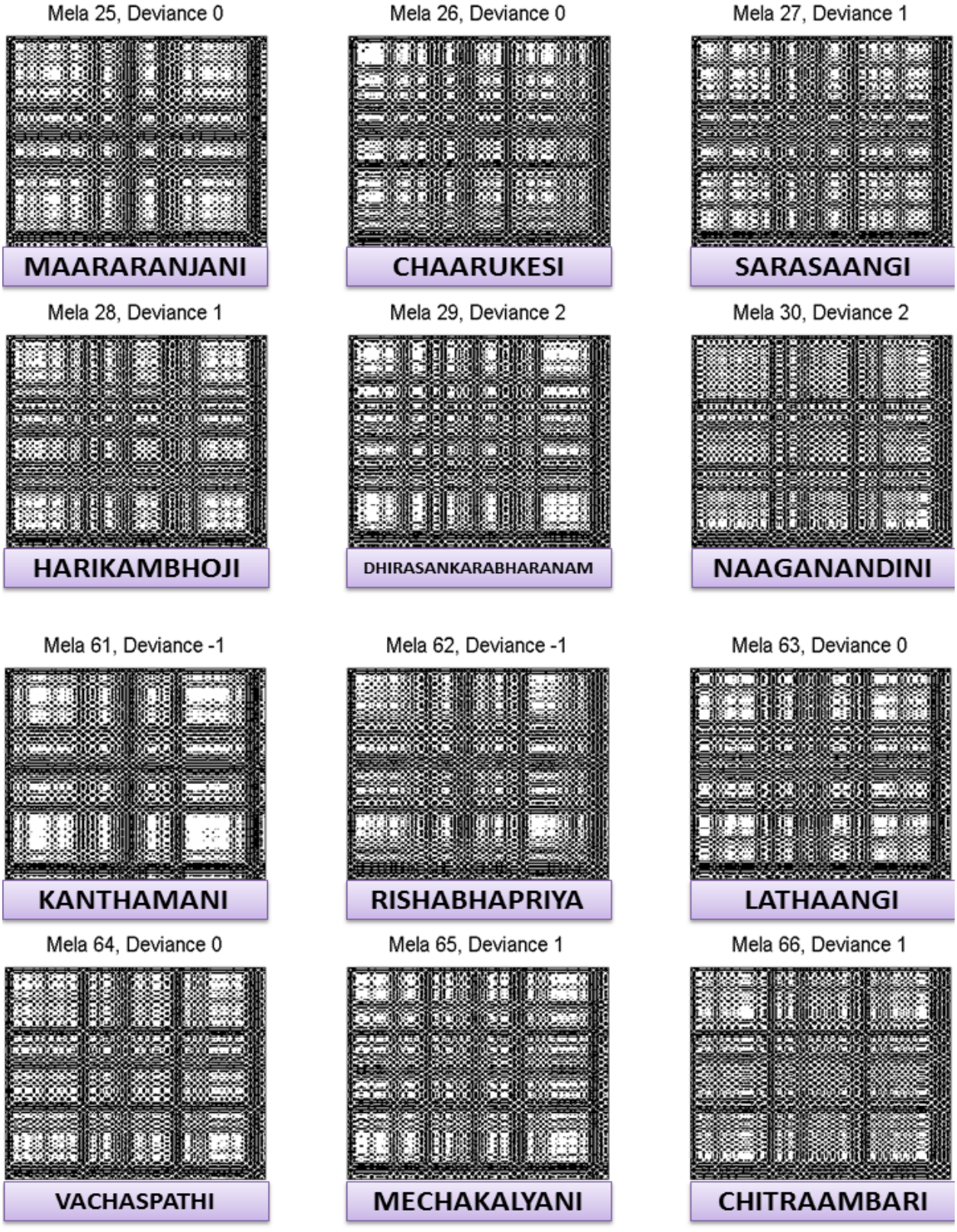

Figure 9 Distance Plots and Deviances for Chakras 5 and 11

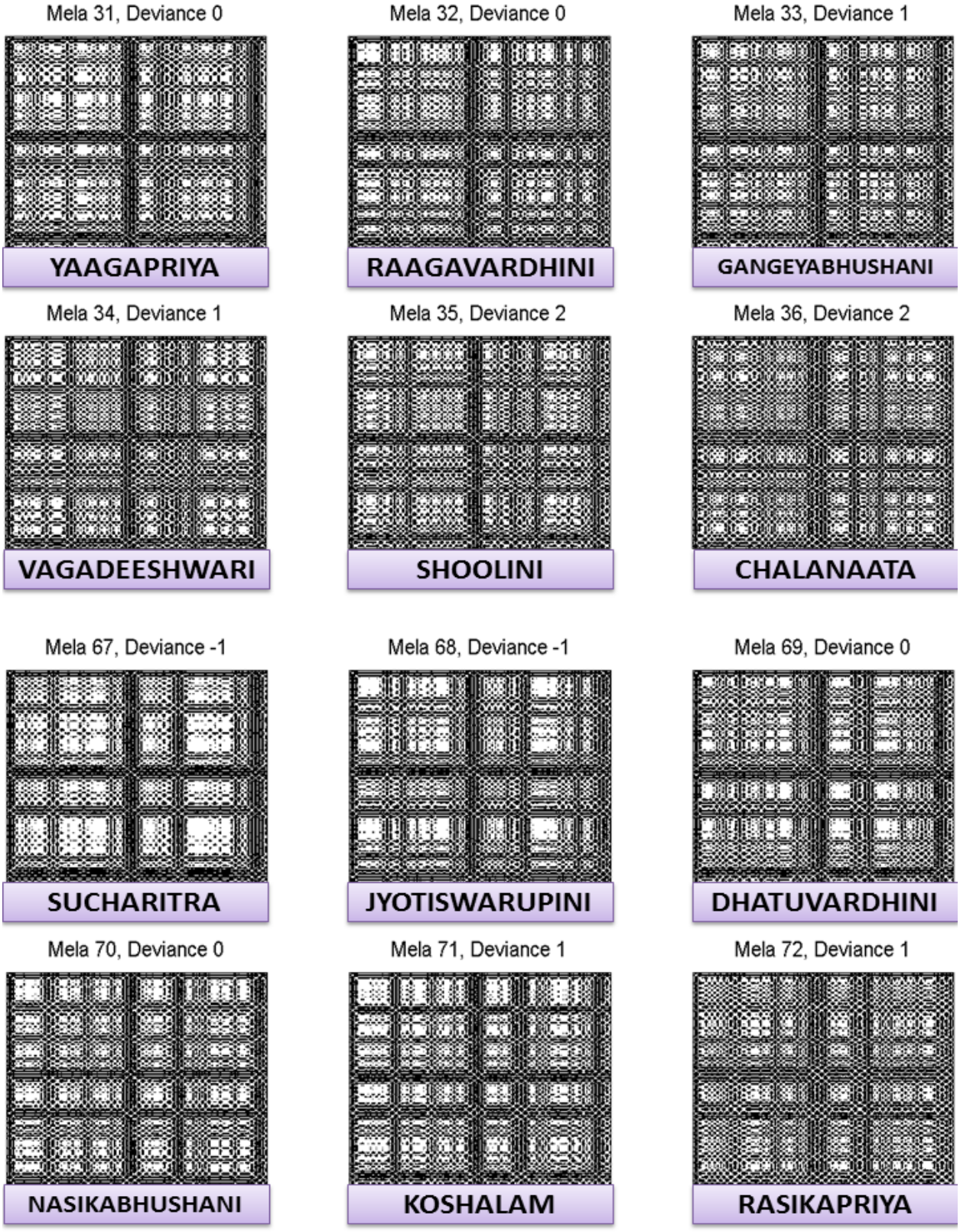

Figure 10 Distance Plots and Deviances for Chakras 6 and 12

Table 1 Mapping the 72 Melakarthas to the 72 Meridians and the associated curable pathologies (H and F stand for Hand and Foot Respectively)

No.	RAAGAM	MERIDIAN	PATHOLOGY	MLE
1	Kanakaangi	JUE YIN H DIVERGENT	hyperventilation, fatigue, vertigo, hypoactive autonomic disorders	8.36
2	Rathnaangi	SHAO YIN H CUTANEOUS	front inner arms	7.07
3	GaanaMoorthi	JUE YIN H SINEW	hand, arm, sterna pain, throb heart	6.74
4	Vanaspathi	JUE YIN H CUTANEOUS	front middle arms and connected areas	3.28
5	Maanaavathi	JUE YIN H COLLATERAL	heart pain, vexation	4.83
6	ThaanaRupi	JUE YIN H MAIN	heart pain, phlegm, cheast/breast pain, lateral costal pain	3.74
7	Senaavathi	TAI YIN H CUTANEOUS	front outer arms, inner abdomen	6.37
8	HanumaThodi	SHAO YIN H MAIN	palpitation, chest pain, insomnia, dry throat, night sweat, arm pain	8.19
9	Dhenuka	SHAO YIN H DIVERGENT	myocarditis, pericarditis, pectoral pain, arrhythmia surg	4.84
10	NaatakaPriya	SHAO YIN H SINEW	chest pain, arm cramp, arm and hand pain	5.06
11	KokilaPriya	YANG QIAO COLLATERAL	loose joints, elbow tendons	3.38
12	Roopaavathi	SHAO YANG H CUTANEOUS	ears, back middle arms	3.21
13	GaayakaPriya	TAI YIN H SINEW	arm, hand, cardiac, rib, panting, spit blood	7.54
14	Vakulabharanam	SHAO YIN H COLLATERAL	fullness in chest, loss of voice	4.37
15	MaayaMaalava Gaula	YANG WEI MAI	unilateral, chill, fever, muscle pain, paralysis, atrophy	5.6
16	ChakraVaakam	YANG QIAO MAI	seizures, ankle disorder, back pain	6.49
17	SooryaKaantham	SHAO YANG H SINEW	arm pain, jaw stiff, lateral headache	5.53
18	Haatakaambari	TAI YANG H CUTANEOUS	back inner arms	5.67
19	JhankaraDhwani	TAI YIN H DIVERGENT	laryngitis, pneumonia, asthma, bronchitis, edema, pleuritis	8.21
20	NathaBhairavi	TAI YIN H MAIN	cough, asthma, chest cong, clavicle, arm pain	9.81
21	Keeravaani	DU COLLATERAL	back pain, stiffness, head tremors	7.08
22	KharaHaraPriya	DU MAI	head, spinal, febrile, nervous, potency, liver wind	5.82
23	GauriManohari	SHAO YANG H COLLATERAL	elbow pain, weakness	5.46
24	VarunaPriya	TAI YANG H SINEW	middle elbow, scapula, ear, jaw, neck pain	5.22

25	MaaraRanjani	TAI YIN H COLLATERAL	heat, wrist pain, yawning, freq urine	8.16
26	Chaarukesi	CHONG MAI	blood disorder, menstruation, gi tract, blood stasis, deficiency	5.59
27	Sarasaangi	SHAO YANG H DIVERGENT	hyperventilation, fatigue, vertigo, hypoactive autonomic	6.57
28	HariKaambhoji	SHAO YANG H MAIN	lateral arm, should, neck p, swelling, sore throat, fever, tinnitus	5.37
29	DhiraSankarabharanam	TAI YANG H MAIN	deafness, burning eye, lower abd. pain, shoulder pain	5.01
30	NaagaaNandini	TAI YANG H DIVERGENT	myocarditis, pericarditis, pectoral p, arrhythmia surg	3.64
31	YaagaPriya	YANG MING H MAIN	nasal discharge, neck, shoulder, arm, wrist, diarrhea, dysentery	7.61
32	RagaVardhini	YANG MING H COLLATERAL	tootache, deafness, bi patterns	6.08
33	GangeyaBushani	YANG MING H SINEW	arm p, spine p, jaw pain	5.81
34	Vaagadheeshwari	YANG MING H CUTANEOUS	back outer arms and neck out	5.61
35	Shoolini	TAI YANG H COLLATERAL	loose joints, elbow tendons	4.32
36	Chalanaata	YANG MING H DIVERGENT	laryngitis, pneumonia, asthma, bronchitis, edema, pleuritis	3.57
37	Saalagam	JUE YIN F DIVERGENT	hepatitis, cholecystic, ileus, liver diseases	7.33
38	Jalaarnavam	SHAO YIN F CUTANEOUS	front inner torso, inner leg	6.38
39	JhaalaVaraali	JUE YIN F SINEW	g toe, m leg, genital p, impotence	5.1
40	Navaneetham	JUE YIN F CUTANEOUS	front 2nd inner legs	5.74
41	Paavani	JUE YIN F COLLATERAL	counterflow, genital pain, swelling	6.77
42	RaghuPriya	JUE YIN F MAIN	low back, abd p, reflux, hernia, test p, anger	4.09
43	Gavaambodhi	TAI YIN F CUTANEOUS	middle side torso, front middle leg	7.51
44	BhavaPriya	SHAO YIN F MAIN	spermatorrhea, asthma, emotional, urination, edema, heart heat	7.47
45	ShubhaPanthu Varaali	SHAO YIN F DIVERGENT	colitis, diarrhea, heammorhoids, fissure, nephritis, cystisis, urethritis, pelvic adhesion	5.61
46	ShadVidha Maargini	SHAO YIN F SINEW	plantar spasm, foot m, epilepsy, fasciculation, spine flex	5.3
47	Suvarnaangi	YIN QIAO COLLATERAL	counterflow, chest cong, constipation, urine block	5.71
48	DhivyaMani	SHAO YANG F CUTANEOUS	outer torso, outer legs	5.12
49	Dhavalaambari	TAI YIN F SINEW	g toe, m ankle, l leg, knee, genital, hips, chest, t spine	6.12
50	NamaNarayani	SHAO YIN F COLLATERAL	counter flow, chest congestion, constipation, urine block	6.68
51	KaamaVardhini	YIN WEI MAI	cardiac pain, emotional, nausea, dizziness	4.51
52	RaamaPriya	YIN QIAO MAI	lumbar weak, lower abd, pubic, lethargy, epilepsy	3.4
53	Gamanaashrama	SHAO YANG F	4toe, stiff knee, rib p, eye disorder	4.66

		SINEW		
54	Vishvaambari	TAI YANG F CUTANEOUS	back torso and legs	3.59
55	Shyaamalaangi	TAI YIN F DIVERGENT	uterine, visceral, cramp, colitis, ileus, gastritis, ulcer, spasm, sinus	6.97
56	ShanmukhaPriya	TAI YIN F MAIN	belch, vomit, reflux, abd bloat, knee pain	6
57	Simhendra Madhyamam	REN COLLATERAL	skin, abdominal disorder	5.56
58	Hemavathi	REN MAI	repro, gyno, damp, phlegm, facial, hernia, stagnation	8.24
59	Dharmaavathi	SHAO YANG F COLLATERAL	tightness, leg weakness	4.6
60	NeethiMathi	TAI YANG F SINEW	l toe, heel, knee b, arch spine, neck spasm, waist r, pectoral	4.49
61	Kaanthaamani	TAI YIN F COLLATERAL	counterflow, cholera intp, abd bloat	8.07
62	RishabhaPriya	DAI MAI	leucorrhea, lumbar abd weak, paralysis, hemiplegia	7.04
63	Lathaangi	SHAO YANG F DIVERGENT	hepatitis, cholecystic, ileus, liver diseases	5.54
64	VaachasPathi	SHAO YANG F MAIN	headache, eye p, hip, costal, leg p	4.16
65	MechaKalyani	TAI YANG F MAIN	urine retention, incontinence, eye p, nasal obstruct, neck/back pain	6.65
66	Chithraambari	TAI YANG F DIVERGENT	colitis, diarrhea, heammorhoids, fissure, nephritis, cystisis, urethritis, pelvic adhesion	3.66
67	Sucharitra	YANG MING F MAIN	borborygmus, abd bloat, vomit, l. appetite, sore throat, knee/leg p	5.85
68	JyothiSwaroopini	YANG MING F COLLATERAL	counterflow, voice loss, mania, depression	6.98
69	DhaathuVardhini	YANG MING F SINEW	m toe, knee, thigh, hernia, abd cramp, dry mouth, eye swell, f paralysis	5.75
70	NasikaBhushani	YANG MING F CUTANEOUS	front torso, front middle legs	7.05
71	Koshalam	TAI YANG F COLLATERAL	nasal congestion, cold, ha, back pain	4.2
72	RasikaPriya	YANG MING F DIVERGENT	uterine, visceral, cramp, colitis, ileus, gastritis, ulcer, spasm, sinus	3.13

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