

**A NEW BIOTECHNOLOGICAL APPROACH TO
COMPENSATE FOR ALTERED PERIPHERAL
SENSORY PERCEPTION**

Thesis submitted to the
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degree of
DOCTOR OF PHILOSOPHY

by
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Dedicated

to

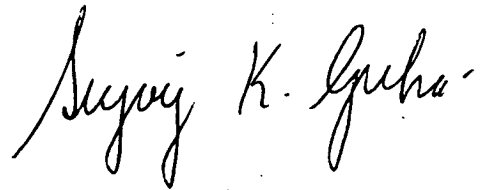
LEPROSY PATIENTS

CERTIFICATE

This is to certify that the Thesis entitled "A NEW BIOTECHNOLOGICAL APPROACH TO COMPENSATE FOR ALTERED PERIPHERAL SENSORY PERCEPTION" being submitted by Shri G.L.Jain to the Indian Institute of Technology, Delhi, India, for the award of the degree of Doctor of Philosophy in Centre for Biomedical Engineering is a record of bonafide research work carried out by him under our supervision and guidance. The Thesis work, in our opinion, has reached the standard fulfilling the requirement for the Doctor of Philosophy Degree. The research report and results presented in this Thesis have not been submitted in part or in full to any other University or Institute for the award of any degree or diploma.



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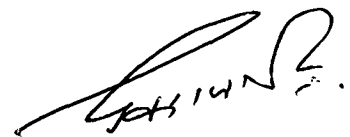
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(G.L.Jain)

ABSTRACT

In the present study, two novel approaches have been tried to prevent disabilities in patients with peripheral sensory loss. One of the approaches adopted was to obtain a visual indication as an alternate of the normal mode of perception of pressure and temperature. A ring type device containing liquid crystal compound was prepared on the basis of an experimental biomechanical study which correlated the expansion of soft tissue mass of proximal phalanx of the finger with gripping force. This expansion was used to displace the liquid crystal layers to obtain its colour change to indicate pressure. For the temperature sensation, implantation of liquid crystal was tried by tattooing and by opening skin split-thickness flap. The difficulties observed in these processes have been discussed. ;

The other approach was to utilise natural biological sensory modalities but with augmentation. This approach was looked into from two different angles. The first part of the study was based on the principle that any chemical released into subcutaneous tissue-bed is transported to the tongue by the blood circulation. Saccharin, which requires a very low threshold concentrations ($23 \mu\text{mol/litre}$) to produce a taste, was chosen for this part of the study. The study which involved injection of saccharin at the affected area and recording the time of perception of sweet taste on 10 leprosy patients, revealed that the time-lag between the

injection of saccharin and the feel of taste in the mouth was too long for practical use of the method as a high temperature indicator.

The second part of the study was to partially or wholly correct the altered threshold of perception at the natural receptor level itself. The study involved objective grading of the loss of temperature, pain and touch sensations. Results showed that the sensory loss were not uniform all over the lesion and it was also not maximum at the centre of the lesion, though generally it was less at the margin in comparison to the central areas. In order to improve the perception, histamine acid phosphate was either injected intradermally or after mixing with DMSO applied topically. A reduction in the sensory loss was observed for all the three sensations but the effect persisted for a limited duration and it was not uniform throughout the area tested. To increase the duration of the effect, a slow and continuous release of histamine by microencapsulation or by bonding with a polymer matrix has been proposed.

The overall results are summarized and critically analysed. The limitations of the different approaches and possible improvement and the scope of further work is outlined.

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