**INTRODUCTION**

Leprosy often causes impairment of autonomic, sensory and motor nerve function in the affected individuals. This in turn leads to secondary impairment or deformities of varying severity in the eyes, face, hands and feet. Ultimately these secondary impairment or damage to the limbs and eyes become irreversible, before the affected person receives the appropriate treatment. Impairment and deformities may cause limitation of activities of daily living and adverse social reaction.

With the advent of effective treatment with multi drug therapy (MDT), the number of leprosy patients needing medical treatment has decreased considerably in the recent years, thus the attention is shifting gradually to fulfill the physical and social needs of those ‘cured’ with multi drug therapy but still left with residual impairments, activity limitation or participation restriction. These might cause long term problems for the individual and place a strain on community resources. The global number of people disabled due to leprosy is estimated to be between one and two million, which is twice the number of leprosy cases currently registered for MDT (Van Brakel et al, 1999, Lep. Review). In order to assist them in performing the ADL and self identified activities, a simple customized partial hand prosthesis was designed for traumatic hand amputees that has helped to restore the basic hand functions safely and to their satisfaction. However such prosthesis has not been tried for the leprosy patients with partial hand absorption.

**The Hand in Leprosy**

Hand function is essential to man’s relationship to his environment if that relationship is tolerable or at least comfortable, if not pleasant or productive. In leprosy, the hand is more commonly affected than the feet and a small proportion of leprosy patients have grossly mutilated hands as a consequence of secondary damage due to loss of nerve function. Unlike other hand disabilities due to peripheral neuropathy or trauma, the absorption of digits is gradual and progressive in leprosy as there is loss of sensation. Patients keep on misusing his insensitive hands while being engaged in certain activities or occupation thereby damaging their limbs.

Incidentally, over the years they get adapted to their environment with the present disability or secondary impairment. However the adaptations or the ways in which the patient performs his ADL or specific occupations are even more risky for causing damage to their insensitive hands. It has been reported that the secondary damage is caused either by

1. Direct injuries
2. Ischemia,
3. Repetitive stress and
4. Mechanical force on open wound (Douglas)

The patient tends to hold most of the objects by side pinch between the thumb and the side of the metacarpal of the index finger and because of the abnormal pressure while holding the objects constantly, the skin breaks down at the points of maximum stress. In the insensitive claw hand the distal tip of every finger would be calloused and the tip of distal pharynx may be felt beneath a scar in front of the fingernails. It is in this position a high proportion of fingertips are found infected. The various patterns of stress that have been outlined may result in break down of skin and perhaps the soft tissue. If the wound is then allowed to heal, there will not be much harm. The real severe and disabling damage occurs after the wound has opened. It spread infection into bones, tendons and joints that results in absorption of whole digits.

**MATERIALS**

10 leprosy patients with partial hand absorption living in a self-settled leprosy colony (Sanjay Gandhi Leprosy Colony, Chunabhatti, in Mumbai) were selected. Out of 10 patients, 6 were males and 4 were females and the age group ranging between 50 – 70 years.

**Inclusion criteria**

1. Patients cured with MDT and not having any active signs of leprosy for the past two years
2. Hand disability graded as ‘Grade - III” on WHO disability grading (WHO, 1988)
3. The pattern of hand disability should be from any one of the following criteria:
- Complete or more than 50% absorption of thumb
- Complete or more than 50% absorption of three or more fingers
- Complete or partial absorption of thumb along with complete or partial absorption of fingers

**Exclusion criteria**
1. Patients who were having active leprosy and on multi-drug therapy for leprosy.
2. Absorption of hand extending beyond metacarpal joints
3. Patients with the absorption up to distal phalanges of finger only

**Assessment**
The hand disabilities of all the patients were assessed and graded on ‘0 – 2’ scale according to the WHO Disability Grading system (WHO, 1988). All the patients were asked about their “self identified goals” and how well they can do these things in a way they want to do. Their response was graded on a scale from ‘0 to 10’; with ‘0’ being that ‘they can’t do them at all’ and with ‘10’ being that ‘they can do them at their best’.

All the patients were assessed for grasp functions (hook, cylindrical, spherical) and prehension (tripod pinch, pulp pinch, lateral pinch). Grip strength and pinch strength of patients were also assessed and graded as strong, weak and poor.

All the patients were assessed using a modified “Green Pasture Activity Scale [GPAS]” (van Brakel, 1999), based on the Activity (Disability) classification of the ICIDH-2. Validity and reliability of testing using the GPAS in a series of pilot studies showed very acceptable results with the leprosy patients. The GPAS consists of 17 activity questions, For each activity the interviewee has to choose one out of five answer categories. Patients were asked to rank the list of activities on a scale of difficulty in performing them i.e. never do this, same as before, some difficulty, much difficulty, only possible with help of aid, not possible. A maximum of five points response scale is used to arrive at sum total of all the points are compared before and after giving the prosthesis.

**METHODOLOGY**
The following partial hand prosthesis was designed and to suit the needs of the individual patients based on their hand disability.

These customized hand prosthesis were prepared out of a mini-perforated thermoplastic material called “EASY FIT”, which is 3.2 mm in thickness. The ideal activation temperature for fabrication is 140°F (60°C).

**Construction of thumb**
Thumb was made in two parts – thumb post and base

**Thumb post**
A piece of ‘Easy fit’ was rolled to make a thumb post. By comparing the thumb post with thumb of other hand, if present or with the thumb of person of similar age, sex and built. The proper thickness and length of post were approximated.

**Base**
This thumb post was placed on hand and another piece of ‘easy fit’ was wrapped around the base of thumb, over the thenar muscles, down to the wrist joint and half way across the dorsum of hand.

Anchoring of this prosthesis was done with Velcro or elastic depending upon the strength of the thenar muscles.

**Construction of hand part**
A rectangular piece of easy fit was taken and moulded on the residual stump of fingers. Elastic or rubber bands were used to anchor this hand part to the hand.

Functional training was given to all the patients for 10 days after the intervention.

**RESULTS**

1. **Hand Functions**
All the patients were compared pre and post intervention for hand functions including three grasps (cylindrical, spherical & hook) and three pinches (side, lateral & tripod).

Before intervention all the ten patients were having side pinch along with hook grasp, and two patients were having cylindrical grasp along with hook grasp and side pinch.

After intervention seven patients acquired pulp pinch, nine patients acquired tripod pinch and all the patients were able to grasp the objects by cylindrical grasp, five patients acquired spherical grasp.

2. On Green Pasture Activity Scale (GPAS)
All the patients were assessed using a structured questionnaire instrument of a modified GPAS to correlate improvement in hand functions with the performance of daily living activities. It was observed that the partial hand prosthesis have helped in performing activities related to ‘EATING’ by 29.1%. While other activities showed marginal improvement in terms of difficulty in performance of a specific activity. The eating activities have improved significantly in good proportion of patients. The other benefits observed were that the female patients could use the stove more effectively with the prosthesis.

It was found that the range of change in the sum score was 13 (26
it is one of the major contributors of the disabled pool in the community. Such mutilated limbs are the identity for generating the stigma in the Society. Maude H. Malic (1975) recommended temporary prosthesis for the partially amputated hand to maintain hand functions and regaining independence in self care of the patient. However this type of hand prosthesis has not been tried on patients with hand disability due to leprosy. Attempts were made by Ganapati et.al (1983) who have successfully tried an ‘epoxy resin’ material (ARALDITE A.V. 1001 IN - with hardener HV1001 IN) for providing hand grips by moulding the handles of various articles used by leprosy patients with improper grip owing to severe mutilation of the hands / fingers. In a multi-centric study, Yawalkar et al (1992) have fitted made-to-measure grip aids using Modulan® to 755 articles for 155 patients with various types of hand deformities due to leprosy. He reported that these grip aids have facilitated a normal grip even with crippled hands. The disadvantage of these grip-aids is that they are useful only for a particular article.

In this study we have made an attempt to make simple customized partial hand prosthesis for the leprosy patients with grossly mutilated hands. This prosthesis is tailor made according to the needs of the individual patient to augment limited function using the crippled hands. We have found that with this partial hand prosthesis, the patients hand function either improved or remained same according to GPAS.

The possible reasons for minimal changes in the GPAS of various activities could be:

1. Though the prehension functions have improved considerably but the strength of pinch and grasp was not appreciable.

### DISCUSSION

Leprosy is a crippling disease because of the nerve impairment and

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### TABLE 1

<table>
<thead>
<tr>
<th>S.N.</th>
<th>Activities</th>
<th>Pre intervention</th>
<th>Post intervention</th>
<th>Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Dressing</td>
<td>9±1.25</td>
<td>8.5±1.5</td>
<td>5.6%</td>
</tr>
<tr>
<td>2.</td>
<td>Eating</td>
<td>8.6±0.52</td>
<td>6.1±2.1</td>
<td>29.1%</td>
</tr>
<tr>
<td>3.</td>
<td>Caring for yourself</td>
<td>2.5±0.53</td>
<td>2.4±0.6</td>
<td>4%</td>
</tr>
<tr>
<td>4.</td>
<td>Preparing meals</td>
<td>8.9±0.57</td>
<td>8.7±1.02</td>
<td>23%</td>
</tr>
</tbody>
</table>

### GRAPH I

Change in the sum score of GPAS
Therefore, only a minimal change was observed in terms of difficulty in performing an activity. Even though the patients were able to perform certain activities, the grasp and pinch did not result in easing out the performance of activity.

Due to gross absorption of the digits, these patients gradually become adapted to their present impairment. Hence, extensive training is required to change their adapted functions so as to perform their basic activities in a safe manner.

It has been stressed that the motivation of patient in learning the use of new prosthesis and using the hand functions gained by this prosthesis for performing daily living activities.

The basic need of all the patients using the hand is ‘eating’, which they have to perform by themselves. Therefore there is no felt need for other specific activities as most of them are engaged in ‘begging’ for their livelihood.

It was noticed that there are certain activities like – peeling the skin of a fruit, breaking chapatti or bread and opening the tap – which patients could not do (not included in GPAS) without prosthesis due to impairment. Patients who were provided with thumb post only were able to write and female patients could pump the primus stove which was earlier difficult task to perform.

In this study we have made an attempt to identify the various goals of leprosy patients with mutilated hands and grade them from 0 to 10 in terms of ‘how well they are achieving their goals’. Surprisingly we found that most of the patients did not have any self identified goals for them. This may be due to the socio economic / psychosocial factors attach with leprosy. Stigma attached with leprosy left these patients aim less and isolated from the society.

CONCLUSION

In leprosy the aim is not only to augment limited functional activities but also enable the patient to perform the activity safely. While constructing the partial hand prosthesis it was found that the donning and doffing is simple and the maintenance is easy. This prosthesis has enabled the patients to either improve or remain as before in terms of their difficulty in performing the activity. It was also found that this prosthesis has facilitated normal hand function and increased the total contact area, thereby eliminated the mechanical factors responsible for secondary damage. It has also enhanced even distribution of stress on the available surface of the hand that has reduced the areas of excessive stress, which has given the patient an option to perform an activity in a near normal manner.

This signifies that even though the level of difficulty in performing the activities remained same for some activity however the patients are now able to perform these activities in safer ways. With the help of the partial hand prosthesis, patients were not only able to perform the activity, but also to do it more safely.

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REFERENCES