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RESEARCH ARTICLE

Should we cut Fingernails?–Importance of Fingernails in Hand Skills

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Abstract

During the study on Rivet and Eyelet Deftness Test, subjects were uncomfortable on some stages of the tests and their scores were affected. One of the reasons for this was fingernail biting habit or recent history of cutting fingernails. Because of hypersensitive or painful fingernail beds they were not able to complete the tasks which required fingernails. Based on these observations, the present study was designed to evaluate the importance of fingernail in hand deftness. Thus, objective of the study was in accordance with difficulty faced during activities of daily living, work and leisure pursuits of an individual. This investigation was aimed to study the contribution of the fingernails in the hand dexterity, check the validity of the modified Rivet and Eyelet Deftness Test to evaluate the contribution of fingernails to hand dexterity and the impact of recently cut fingernails on the performance on the modified Rivet and Eyelet Deftness Test. Rivet and Eyelet Deftness test was used for evaluating dexterity. However, there were some limitations with respect to the present study objective and they are: It was lengthy test and it did not have stage to evaluate the importance of both hand fingernails. Taking these limitations in to consideration, modification in the Rivet and Eyelet Deftness Test was done. It consisted of eight stages instead of seven and each stage time was reduced to 30 sec from 60 sec. Rivet removal items were used for studying the fingernails contribution. After recent fingernail cutting, the scores of preferred hand, non-preferred hand and both hand use have reduced drastically. It is found that there is a significant correlation between fingernails cut duration and the tasks involving use of the fingernails while picking up rivets. Fingernails have definite contribution to hand dexterity and modified Rivet and Eyelet Deftness Test is a valid tool for evaluating the same in human hands.

Keywords: Dexterity, modified Rivet and Eyelet Deftness test, hand deftness, fingernail, non-preferred hand.

Introduction

The fingernail in humans has evolved phylogenetically with the development of manual dexterity (Gonzalez-Serva, 1990). The nail also protects the fingertip and contributes to tactile sensation (Zook, 1980). Apart from cosmetic, esthetic purposes, fingernails communicate social status. Chinese noblemen grew long nails to demonstrate their avoidance of any type of manual work. There are many tasks which one performs during activities of daily living activities where fingernails are required, such as lifting coin from the flat surface, buttoning, unbuttoning, cleaning nose, scratching inner side of ear, removing lid, tearing paper or other fine sheets, tailors use it for making a mark on the cloth, removing cello tape and many more.

Dexterity, defined as the skillful manipulation of the hands (Wiesendanger and Serrein, 2001). It is divided into finger dexterity and manual dexterity (Flieschman and Ellison, 1962). Manual dexterity is gross motor dexterity and usually involves hand and upper extremity. Commonly used tests used for evaluating manual dexterity are Minnesota Rate of Manipulation Test, Minnesota Manual Dexterity Test.

Other type of Dexterity is finger dexterity and is evaluated by Purdue Pegboard Test, O'Connor Finger Dexterity Test and others. These tests definitely measure finger dexterity but have limitation in differentiating role of fingernails from pad during dexterous activity. The main factor for this limitation was related to the tasks used for evaluation of hand dexterity. The task used for testing dexterity does not require fingernails for performing the sub tests. Inoue and Hirai (2007) mentioned that, in addition to allowing us to pick up small objects, the fingernails are essential for the high-level sensitivity and as a buttress for the pad. He concluded that the structure of a finger consisting of a soft fingertip and a hard fingernail enhances dexterity in grasping and manipulation. Inoue and Hirai (2007) needed to study the importance of the fingernail when he was designing robotic hand. Various functions of the fingernails are enumerated including dexterity, but its contribution to dexterity was never measured. Very few authors mention about the role of fingernails in dexterity, but there is no test, which will correlate to the dexterity scores. Most of the dexterity tests available do not require fingernails to complete the stages or sub-tests and therefore they are not sensitive to point out the role fingernails to the hand deftness.

Popularly used hand dexterity tests like Purdue Pegboard Test (Lafayette Instruments, 1999), MRMT manual does not even mention about role of fingernail in the hand dexterity (Yancosek and Howell, 2009). During the study on Rivet and Eyelet Deftness Test, subjects were uncomfortable on some stages of the tests and their scores were affected. One of the reasons for this was fingernail biting habit or recent history of cutting fingernails. Because of hypersensitive or painful fingernail beds, they were not able to complete the tasks which required fingernails. The stages were Right hand removal and Left hand removal (Nandgaonkar, 2002). Based on these observations, a study was designed to evaluate the importance of fingernail in hand deftness. Thus, objective of the study was in accordance with difficulty faced during activities of daily living, work and leisure pursuits of an individual and conducted with the following objectives:

1. To study the contribution of the fingernails in the hand dexterity.
2. To check the validity of the modified Rivet and Eyelet Deftness Test to evaluate the contribution of fingernails to hand dexterity.
3. To study the impact of recently cut fingernails on the performance on the modified Rivet and Eyelet Deftness Test.

Materials and methods

Participants: After getting permission from Institutional Ethics Committee, participants were recruited from various departments of the college and hospital. Initial contact took place through the direct contact. Participants who took part in the study were in turn requested to refer more from their departments. No formal advertisement was done. Those who approached were evaluated for following inclusion and exclusion criterion. All participants were of Indian from urban setup (Mumbai, Navi Mumbai and Thane regions).

Inclusion criterion:

1. Age group, between the ages of 18 to 44 years of age.
2. Bothe male and female was included.
3. Ability to follow the test instructions thereby signifying an average intelligence.
4. Functional visual acuity.

Exclusion criterion: History of any accidental injury to hand or fingernails or upper extremity or not suffering from any disease or chronic disabling condition (no orthopedic or neurological dysfunction, no congenital abnormality).

Hypothesis

Research hypothesis: There is contribution of the fingernails to the hand dexterity.

Null hypothesis H_o: There is no contribution of the fingernails to the hand dexterity

Rivet and Eyelet Deftness Test: It was used for evaluating dexterity. Validity and reliability of the instrument for evaluating dexterity was checked. However, there were some limitations with respect to the present study objective. They were:

1. It was lengthy test (60 sec for each stage).
2. It did not have stage to evaluate the importance of both hand fingernails.

The above mentioned limitations were taken in to consideration and modification in the Rivet and Eyelet Deftness Test were done. It consisted of eight stages instead of seven and each stage time was reduced to 30 sec from 60 sec. Rivet removal items were used for studying the fingernails contribution. It is non-verbal in nature that tests for both unilateral (Stage I through IV) and bi-manual tasks (Stage V through VIII).

Procedure: Consent to undergo the test was taken from the subject. Once ready, explain to the subject the purpose of test. Also the procedure to be followed is explained. Subject is sitting on the chair with the table in the front on which test equipment is placed. The Wooden test platform is placed vertically on the table. The platform has the two columns of holes (25 holes on each side). The holes are drilled in such a way that there is a gap after every five holes, so that the counting becomes easier. The depth of the hole is adequate for the height of the rivets to be inserted. On the far end of the platform, there are four containers for the storage of the rivets and eyelets. Each time the subject has to pick up the rivet or eyelet from these containers. Sitting arrangement was made comfortable. Practice test was given so that the subject is acquainted with the test and can perform well and the test score is not affected. Also the test is taken in quite room so the distraction can be avoided. Data is recorded with one trial procedure. This test had eight stages that yield eight separate scores.

Sequence of procedure

Stage I–Right hand insertion (with right hand only) (RHI):

Preparation: All the holes on the wooden testing platform should be empty. Take out one rivet at a time from the container on right side and put it into hole on the right side of the platform (start from the hole which is nearer to the subject) only with right hand. Repeat the procedure till the examiner tells to stop (Duration–30 sec only). If the entire column on right hand side of the platform is complete, then the subject is allowed to continue in column on left hand side of the platform (Start from the hole, which is nearer to the subject)

Stage II–Right hand removal (with right hand only) (RHR):

Preparation: All the holes on the wooden platform should be filled with the rivets. Remove the rivet, one at a time, from the holes only with right hand and putting back into the rivet compartment. Repeat the procedure till the examiner tells to stop.

If the entire column on right hand side of the platform is empty, then the subject is allowed to continue in column on left hand side of the platform (Start from the hole, which is nearer to the subject).

Stage III–Left hand insertion (with left hand only) (LHI):
Preparation: All the holes on the wooden testing platform should be empty. Take out one rivet at a time from the container on left side and put it into hole on the left side of the platform (Start from hole which is nearer to the subject) only with left hand. Repeat the procedure till the examiner tells to stop (Duration–30 sec only). If the entire column on left hand side of the platform is complete, then the subject is allowed to continue in column on right hand side of the platform (Start from the hole, which is nearer to the subject).

Stage IV–Left hand removal (with left hand only) (LHR):
Preparation: All the holes on the wooden platform should be filled with the rivets. Remove the rivet, one at a time, from the holes only with left hand and putting back into the rivet compartment. Repeat the procedure till the examiner tells to stop. If the entire column on left hand side of the platform is empty, then the subject is allowed to continue in column on right hand side of the platform (Start from the hole, which is nearer to the subject).

Stage V–Both Hand Insertions (with both hands) (BHI):
Preparation: All the holes on the wooden testing platform should be empty. Simultaneously take out one rivet at a time from the container on right side and from the container on left side with the help of right and left hand respectively. Then, simultaneously put each one into hole on the right side of the platform and hole on left side of the platform respectively (Start from hole that is nearer to the subject). Repeat the procedure till the examiner tells to stop (Duration–30 sec only).

Stage VI–Both hand removals (with both hands) (BHR):
Preparation: All the holes on the wooden platform should be filled with the rivets. Simultaneously take out one rivet at a time from the hole in right side column and from the hole in left side column with the help of right and left hand respectively. Then, simultaneously rivets into the container on the right side of the platform and hole on left side of the platform respectively (Start from hole that is nearer to the subject). Repeat the procedure till the examiner tells to stop (Duration–30 sec only).

Stage VII–Assembly (with both hands) (AI):
Preparation: All the holes on the wooden testing platform should be empty. Take out one eyelet with one hand and one rivet with another hand and assembling it in such a way that the eyelet is inserted into rivet, so that the broader end of eyelet is facing below. With such an assembly put the rivet into the hole on the platform (which is nearer to the subject) (Duration–30 sec only).

Stage VIII–Assembly removal and separation (with both hands) (AR):
Preparation: All holes on the wooden platform should be filled with assembly units as mentioned in Stage VII. Remove the assembly created in the Stage VII from the hole, one assembly at a time and separating eyelet and rivet with the help of both the hands and the putting them back into the respective containers (Duration–30 sec only). If the entire column on one side of the platform is empty, then the subject is allowed to continue in column on the other side of the platform (Start from the hole, which is nearer to the subject).

Scoring: The number of holes completed successfully (insertion, removal or removal and separation) are counted and entered on the score sheet.

Specific guidelines followed: Subjects were not allowed to take eyelet or rivet dropped outside the specified container. The subject has to collect the rivet or eyelet from the container only. They can choose from any container which is comfortable to them. In addition to noting scores of different stages of modified Rivet and Eyelet Deftness Test, information was collected about following parameters

1. How many days back fingernails were cut?
2. Which is the preferred hand?
3. Weight and height of the subject.
4. History of any other illness.
5. Nail biting habit.
6. Observation during testing like use of the body to manipulate the rivets and eyelets.
7. Education and occupation.

Statistical analysis: Analysis was done after collection of the data. The analysis was performed using SPSS 17.0 (SPSS, Chicago, IL). Standard methods of parametric statistics were used. The level of significance was set at P = 0.05 (Johnston *et al.,* 1992).

Results

Study was conducted on 1226 adult subjects, both males and females staying in urban areas of India (Mumbai, Navi Mumbai and Thane regions) (Table 1). All the subjects were right hand dominant. For analysis, the subjects were divided into two groups based on the number of days have passed since they have cut their fingernails.
Group A: Who cut their fingernails very recently i.e. one or less than one day.
Group B: More than one day has passed since they have cut their fingernails.

Table 2 shows that the highest score among different stages of modified Rivet and Eyelet Deftness Test is of both hand removal and lowest score is of assembly insertion. Also, preferred hand score were higher than non-preferred hand.

Table 1. Mean, standard deviation and standard error of mean of all the subjects.

	N	Range	Minimum	Maximum	Sum	Mean		S.D	Variance
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic
Age	1226	26	18	44	35110	28.64	.201	49.709	7.050
Female	610	0	1	1	610	1.00	.000	.000	.000
Male	616	0	1	1	616	1.00	.000	.000	.000
Weight	1226	43.0	37.0	80.0	69619.0	56.785	.2560	80.376	8.9653
Height	1226	43	143	185	197756	161.30	.214	55.928	7.479
Body mass index	1226	17.90	15.40	33.30	26766.87	21.8327	.09108	10.171	3.18917
Nail cut duration	1226	89	1	90	7543	6.15	.267	87.267	9.342

Table 2. Scores on modified Rivet and Eyelet Deftness Test in the Group B.

		RHI	RHR	LHI	LHR	BHI	AI	BHR	AR
Female	Mean	13.44	17.74	11.21	16.65	17.53	6.05	16.67	28.00
	N	430	430	430	430	430	430	430	430
	S.D	1.745	2.953	1.694	2.545	3.248	.715	2.402	5.663
	Std. Error of Mean	.084	.142	.082	.123	.157	.034	.116	.273
	Minimum	11	11	7	11	8	5	12	16
	Maximum	17	22	16	21	26	8	22	44
Male	Mean	13.05	17.02	11.36	15.83	17.75	5.86	16.32	26.77
	N	456	456	456	456	456	456	456	456
	S.D	2.159	3.749	1.355	3.100	2.916	1.126	2.918	6.190
	Std. Error of Mean	.101	.176	.063	.145	.137	.053	.137	.290
	Minimum	7	4	8	5	12	3	10	6
	Maximum	17	22	13	22	24	7	22	36

Table 3. Scores on modified Rivet and Eyelet Deftness Test in the Group A.

		RHI	RHR	LHI	LHR	BHI	AI	BHR	AR
Female	Mean	13.78	12.61	11.72	14.44	17.22	6.44	17.39	22.89
	N	180	180	180	180	180	180	180	180
	S.D	1.401	4.982	1.525	3.068	2.329	1.015	2.367	7.300
	Std. Error of Mean	.104	.371	.114	.229	.174	.076	.176	.544
	Minimum	11	4	9	9	12	5	13	10
	Maximum	16	21	14	20	20	9	21	30
Male	Mean	12.63	10.88	12.13	12.38	17.50	5.88	15.00	19.75
	N	160	160	160	160	160	160	160	160
	S.D	1.499	3.867	1.057	4.568	1.664	.930	2.186	9.953
	Std. Error of Mean	.119	.306	.084	.361	.132	.074	.173	.787
	Minimum	10	4	11	3	16	4	11	4
	Maximum	15	17	14	18	20	7	18	34

Table 4. Difference in scores on modified Rivet and Eyelet Deftness Test stages between Group A and Group B.

	Group A		Group B	
Modified RED stages	Males	Females	Males	Females
RHI/RHR	86.14%	91.50%	134.03%	131.99%
LHI/LHR	102.06%	123.20%	141.07%	148.25%
BHI/BHR	112.85%	132.92%	154.29%	159.72%

Table 5. Difference in scores on modified Rivet and Eyelet Deftness Test stages between Group A and Group B (Males and Females).

Modified RED stages	Males	Females
RHI/RHR	47.89%	40%
LHI/LHR	39.01%	25.05%
BHI/BHR	41.44%	26.80%

Table 6. Correlation between scores on different stages of modified RED test and age, nails cut duration and BMI (Male).

N = 616		RHI	RHR	LHI	LHR	BHI	BHR	AI	AR
Age	Pearson Correlation	-.316**	-.239**	-.251**	-.225**	-.437**	-.195**	-.369**	-.522**
	Sig. (1-tailed)	.000	.000	.000	.000	.000	.000	.000	.000
BMI	Pearson Correlation	-.205**	-.276**	-.187**	-.362**	-.444**	-.427**	-.220**	.126**
	Sig. (1-tailed)	.000	.000	.000	.000	.000	.000	.000	.001
Nail cut duration	Pearson Correlation	-.057	.454**	-.112**	.435**	.075*	.397**	.070*	.119**
	Sig. (1-tailed)	.080	.000	.003	.000	.031	.000	.040	.002

**Correlation is significant at the 0.01 level (1-tailed), *Correlation is significant at the 0.05 level (1-tailed).

Table 7. Correlation between scores on different stages of modified RED test and age, nails cut duration and BMI (Female).

N = 616		RHI	RHR	LHI	LHR	BHI	BHR	AI	AR
Age	Pearson Correlation	-.004	.241**	.009	.260**	-.203**	.090*	.409**	1
	Sig. (1-tailed)	.461	.000	.417	.000	.000	.013	.000	
BMI	Pearson Correlation	-.053	.008	-.033	.040	.025	-.044	.215**	.220**
	Sig. (1-tailed)	.094	.422	.206	.161	.265	.141	.000	.000
Nail cut duration	Pearson Correlation	-.142**	.118**	-.110**	.047	-.113**	.182**	.044	-.059
	Sig. (1-tailed)	.000	.002	.003	.126	.003	.000	.140	.073

**Correlation is significant at the 0.01 level (1-tailed), *Correlation is significant at the 0.05 level (1-tailed).

Table 8. Mean and S.D of all the subjects of BMI, height, weight and age and correlation between them.

		Body mass index	Height	Weight	Age
Body mass index	Pearson Correlation	1	-.167**	.820**	.136**
	Sig. (2-tailed)		.000	.000	.000
Height	Pearson Correlation	-.167**	1	.417**	-.035
	Sig. (2-tailed)	.000		.000	.226
Weight	Pearson Correlation	.820**	.417**	1	.127**
	Sig. (2-tailed)	.000	.000		.000
Age	Pearson Correlation	.136**	-.035	.127**	1
	Sig. (2-tailed)	.000	.226	.000	

**Correlation is significant at the 0.01 level (2-tailed).

Table 3 shows that, in group A, the highest score among different stages of modified Rivet and Eyelet Deftness Test is of both hand removal and lowest score is of assembly insertion. Preferred hand scores are high for Rivet insertion task but not for rivet removal task. This indicates affected preferred hand scores because of the fingernail cut. Difference in scores on modified Rivet and Eyelet Deftness Test stages between group A and group B is shown in Table 4. Table 5 indicates that because of the recent fingernail cutting, males were affected more than females. This is true for preferred hand, non-preferred hand and both hand use. Modified Rivet and Eyelet Deftness test scores shows negative correlation with age of the individual and BMI (Table 6). This means that as the age or BMI increases, dexterity decreases. In males, as the number of days since fingernails are cut increases dexterity scores (Positive correlation with RHR, LHR, BHR and AR). Negative correlation may be related to difficult in hand manipulation because of long fingernails. In females, Modified Rivet and Eyelet Deftness test scores showed positive correlation with age of the individual and not with BMI. This means that as the age increases, dexterity also increases (Table 7).

Table 9. Difference between different stages of the modified Rivet and Eyelet Deftness Test in Group B (T-test).

Paired samples correlations				
		N	Correlation	Sig.
Pair 1	RHI and RHR	886	.445	.000
Pair 2	RHI and LHI	886	.588	.000
Pair 3	LHI and LHR	886	.363	.000
Pair 4	BHI and BHR	886	.362	.000
Pair 5	AI and AR	886	.491	.000
Pair 6	BHI and AI	886	.382	.000
Pair 7	BHR and AR	886	.498	.000
Pair 8	RHR and LHR	886	.715	.000

In females, as the number of days since fingernails are cut increases dexterity scores. None of the subject was obese or overweight. The correlation is significant at 0.01 level (2-tailed) between BMI and height (negative correlation), weight and age of the subject (positive correlation) (Table 8). Table 9 indicates that in group B, there is a significant difference in scores of dominant and non-dominant hand for rivet removal and insertion, bilateral and unilateral task, tasks requiring fingernails use and not requiring fingernails.

Discussion

To study the contribution of fingernails to hand deftness, modified Rivet and Eyelet Deftness Test was used. It consists of eight stages which subject completes in 30 sec each. Scores were recorded and analysed. Additionally information about how many days back the fingernails were cut was also gathered. Total 1226 subjects, both males and females participated in the survey. Analysis was done after collection of the data. The analysis was performed using SPSS 17.0 (SPSS, Chicago, IL). Standard methods of parametric statistics were used. The level of significance was set at P = 0.05 (Mark, 1992). It was observed that each stage of the modified Rivet and Eyelet Deftness Test represented different score and there was a significant difference among them suggesting different demands by each stage (Table 9) (Paired Differences at 95% confidence interval, significance 2-tailed). We need to analyze this carefully. Each subtest of the modified Rivet and Eyelet Deftness Test presents different challenges for the person performing this test. The characteristics of the each test are:

Stage I: Requires the use of the dominant hand, requires doing in hand manipulation (Pratt and Allen, 1990) with the rivets to select the rivets and then orient in the particular direction so that it can be inserted into the holes on the board.

Stage II: Requires using the dominant hand, but does not require doing in hand manipulation. But this subtest requires using fingernails to pull out rivets from the holes on the board. This is relatively structured task.

Stage III: Requires the use of the non-dominant hand, requires doing in hand manipulation with the rivets to select the rivets and then orient in the particular direction so that it can be inserted into the holes on the board.

Stage IV: Requires using the non-dominant hand, but does not require doing in hand manipulation. But this subtest requires using fingernails to pull out rivets from the holes on the board. This is relatively structured task.

Stage V: Requires the use of both the hands i.e. the dominant and the non-dominant hand, requires doing in hand manipulation with both the hands to select the rivets and then orient in the particular direction so that it can be inserted into the holes on the board. This bilateral activity requires symmetrical use of the hand.

Stage VI: Requires use of both the hands. Both the hands pull out the rivets with the help of the fingernails. This stage too requires symmetrical use of the hand.

Stage VII: Requires the use of both the hands, in hand manipulation with both the hands. In hand manipulation with either hand is of the different objects, in one hand rivet and another hand eyelet. This stage is made more complex as the orientation of the eyelet should be with broader end down while inserting the assembly into the hole. Reorienting the prepared assembly to insert in the hole is added challenge. This stage requires asymmetrical use of both the hands.

Stage VIII: Requires asymmetrical use of both the hands but does not require doing in hand manipulation. Fingernails not required.

In group A, preferred hand scores are high for Rivet insertion task, but not for rivet removal task. This indicates preferred hand scores affectation after recent fingernail cut. Another reason might be related to the individual's tendency to cut fingernails of the dominant hand rather than both the hands (Table). After recent fingernail cutting, the scores of preferred hand, non-preferred hand and both hand use have reduced drastically for the tasks on the modified Rivet and Eyelet Deftness test, which requires fingernails ($p<0.01$, 2-tailed significance, 95% confidence interval, t-test for equality of Means). Females are less affected than their male counterparts. This may be related to females' early adaptation after fingernail cutting. Reasons might be importance and requirement in daily life, personal and social expectations for the hand use. Also dexterous female hands might be defter is adapting to the change and that is what we were checking for, dexterity. In studies of the healthy individuals using Purdue Pegboard Test and Box and Block Test, it is observed that females performed better than males. Also dominant hand showed better performance. After data analysis of modified Rivet and Eyelet Deftness Test, same findings confirmed (Table). In addition, there is positive relationship (Correlation is significant at the 0.01 level, 2-tailed) between dexterity and age of an individual. This suggests that as the age increases the dexterity also increases until certain age. This also confirms the validity of the test to study the variation of deftness across different age groups. Effect of age, gender and hand dominance have effect on the dexterity is shown in many studies (Michimata *et al.,* 2008). This study also confirmed these findings.

It is found that there is a significant correlation between fingernails cut duration and the tasks involving use of the fingernails while picking up rivets. The correlation is positive ($p<0.01$, 1-tailed), which means that as the number of days increases when the fingernails have been cut; the dexterity score on the tasks requiring fingernails also increases. These stages are Right Hand Removal, Left Hand Removal and Both Hand Removal. This indicates that the adequate length of fingernails is required for the some tasks in daily life. This also shows that modified Rivet and Eyelet Deftness Test is sensitive to evaluate the contribution of the fingernails to dexterity.

This also supports the content validity of the test. Also depicts the impact of fingernails cutting on the stages Right Hand Removal, Left Hand Removal and Both Hand Removal where fingernails are required to remove rivets. This suggests that fingernails have significant contribution to hand deftness. Negative correlation with modified Rivet and Eyelet Deftness Test scores ($p<0.01$, 1-tailed) on insertion stages may be related to the effect of long fingernails on in hand manipulation. We can conclude that, fingernails have definite contribution to hand dexterity and modified Rivet and Eyelet Deftness Test is a valid tool for evaluating the same in human hands.

Evolved model for activity analysis in dexterous task:
Based on the characteristics of each subtest and score obtained in the experiments, various models were designed. Figure 1 shows the contribution of the fingernails to the hand dexterity. In the cyclic fashion, it shows how fingernails influence the dexterity in long fingernails and recently cut fingernails. Long fingernails affect in hand manipulation and short fingernails affects hand object coupling, which in turn influences the dexterity scores.

Fig. 1. Contribution of the fingernails to the hand dexterity.

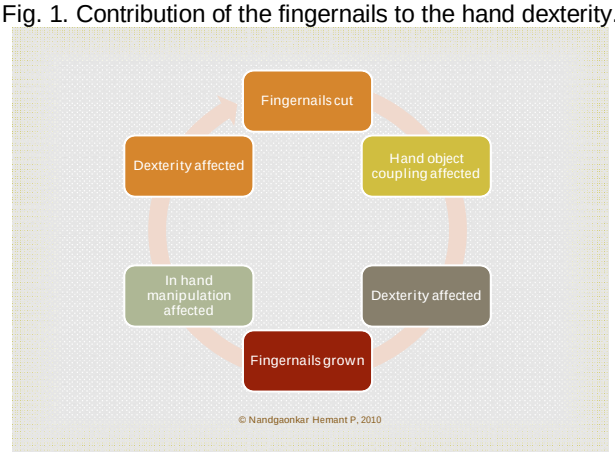
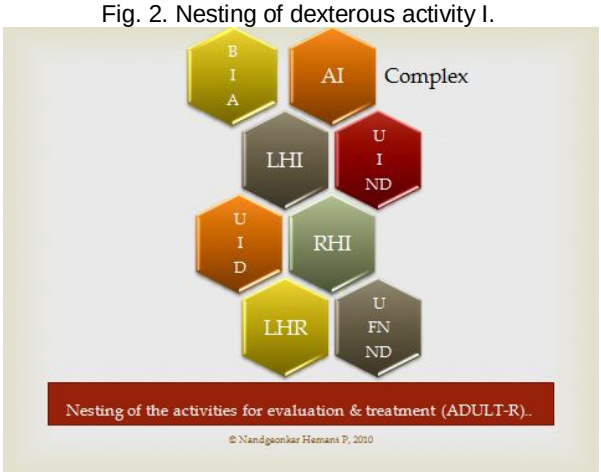


Fig. 2. Nesting of dexterous activity I.



B–Bilateral, U–Unilateral, I–In hand manipulation required, FN–Finger nails required, A–Asymmetrical, S–Symmetrical, D–Dominant hand required, ND–Non-dominant hand required.

Fig. 3. Nesting of dexterous activity II.

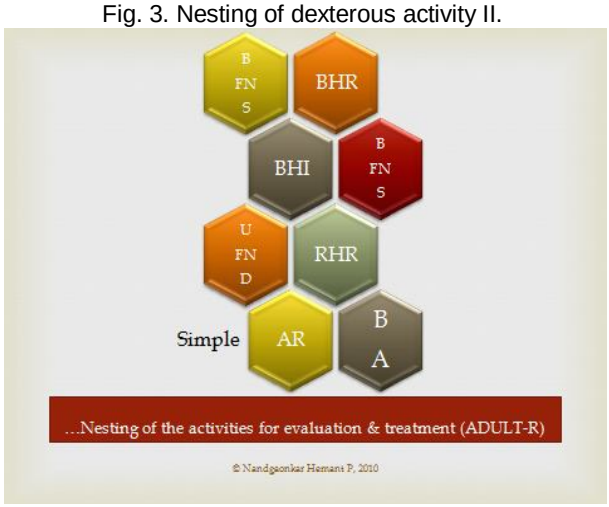


Figure 2 shows different demands of the RED test depending on the complexity of the subtest. AI, LHI, RHI, LHR are categorized as 'Complex' based on the score on the test. The adjacent hexagon indicates the requirements to complete the subtest. These can be considered as components to make task simpler or tougher based on the functional status of the hand. Also this hierarchy should not be rigid as it is knotted with the prior or later stage to create a nest. As this experiment was done on adult population with right preferred hand, it should be applied on the similar population. This concept can be used during evaluation as well as intervention. Figure 3 shows different demands of the RED test depending on the complexity of the subtest. BHR, BHI, RHR, AR are categorized as 'Simple' based on the score on the test. The adjacent hexagon indicates the requirements to complete the subtest. These can be considered as components to make task simpler or tougher based on the functional status of the hand. Also this hierarchy should not be rigid as it is knotted with the prior or later stage to create a nest. As this experiment was done on adult population with right preferred hand, it should be applied on the similar population. This concept can be used during evaluation as well as intervention.

Conclusion

The study confirms the contribution of the fingernails in the dexterous task. Findings also brings the attention to the optimal length of the fingernails is required to for accuracy, speed and coordination in the dexterous task. It should not be too long or too short.

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