Original Article

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Dentistry Section

Comparison of Non Surgical Periodontal Treatment Outcome and Clinician's Comfort Levels using LM ErgoMax over Hu-Friedy Hand Instruments- A Randomised Clinical Trial

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ABSTRACT

Introduction: Non surgical periodontal therapy by scaling is done by using different sets of hand and motor driven instruments. The best instrument for non surgical periodontal therapy has to be identified, so that, it will benefit the clinicians in point of ergonomics and for patients in terms of less discomfort caused during scaling.

Aim: To compare the effectiveness of Linear Monolithic (LM) instruments to Hu-Friedy instruments in non surgical periodontal treatment.

Materials and Methods: The split-mouth randomised clinical trial study comprised 50 patients, who were selected from those attending the Department of Periodontics and Implantology, Vishnu Dental College, Bhimavaram, Andhra Pradesh, India, and who were classified with gingivitis or moderate to severe periodontitis according to American Academy of Periodontology (AAP) standards from 1999 and had not undergone any periodontal therapy in the previous six months to one year. The study was conducted from September 2021 to February 2022. Periodontal treatment outcomes were evaluated by plaque index, bleeding index, probing pocket depths, gingival index and clinical attachment level. Clinicians comfort levels and handling characteristics of two sets of hand instruments (Test: LM instruments to control: Hu-Friedy instruments) were assessed by questionnaire consisting of 10 closed ended questions immediately after the non surgical therapy. The unpaired t-test was used for intergroup analysis and one-way ANOVA was used for intragroup analysis.

Results: The mean gingival index scores for test and control sites at baseline were (1.65 and 1.72), at one week were (0.89 and 0.64) and at one month were (0.46 and 0.31). The mean periodontal pocket depth for test and control sites at baseline were (3.93 and 3.79), at one week were (3.40 and 3.25) and at one month were (3.18 and 2.42). A statistically significant difference seen in gingival index ($p=0.001$), sulcus bleeding index ($p<0.001$), periodontal probing depths ($p<0.001$) and clinical attachment level ($p<0.001$) at one-month interval.

Conclusion: The findings demonstrate that LM instruments have higher handling features and cutting efficiency than Hu-Friedy instruments, although there is no significant difference in plaque index, gingival index, probing depth reduction, sulcus bleeding index, or clinical attachment level.

Keywords: Linear monolithic ErgoMax, Non surgical therapy, Subgingival debridement

INTRODUCTION

Dentists can produce good non surgical periodontal therapy treatment outcomes by combining manual and power instruments. Both modalities are more important and effective than ever because of the newly developed designs. Dentists may now provide patients with the best periodontal care possible in order to increase clinical effectiveness, enhance outcomes and eventually benefit individuals by delivering superior dental and general healthcare [1].

Due to the ineffective instrumentation, or due to improper selection of instruments, the infection or disease process can frequently develop in unresolved regions depending on the host's reaction to inflammation. To decrease chronic gingival inflammation after non surgical periodontal therapy, hand instrumentation must involve full biofilm and calculus removal [1].

There are many different dimensions, shapes, materials, weights and comfort options for tool handles. Hand devices with varied handle diameters can help prevent hand stress and repetitive motion injuries. Clinician comfort is a significant concern in handling selection, which is crucial in reducing repetitive strain injuries. Larger diameter handles may reduce hand fatigue and finger cramps. The optimal handle weight is 15 gms or less, and the ideal handle diameter is atleast 10 mm [2].

Tools with patterned grip surfaces or other surface coatings may help to create friction among gloved fingers and the tool, minimising pinching forces, because clinician comfort is the most crucial element [3]. Tool handles made of plastic as well as alloy steels with such an etching process decorative pattern avoid slippage and provide a firm grip. Since 1908, Hu-Friedy has been extensively utilised because to its exceptional quality and is regarded as an innovative dental product in the hands of dental experts all over the world [4].

Linear Monolithic (LM) Ergomax is constructed of an extraordinarily durable unique metal alloy with a protective micro-membrane covering that improves wear resistance and reduces the time required on routine dental tool maintenance. The fundamental benefit of LM over Hu-Friedy is that LM employs a combined ideal feature of higher sharpness and tactile sensitivity, as well as increasing instrumentation comfort [5].

With an increasing understanding of the relationship between periodontal health and systemic health it is critical to provide

accurate, comprehensive and pleasant periodontal diagnostic and treatment choices. Hand instrument designs and materials for dental hygiene treatment are constantly developing and improving, presenting dental hygienists with the problem of choosing the proper tool for each clinical setting [4,5].

There is currently no research comparing ergonomics and clinical outcomes of these two instruments. Thus, the primary goal of the present study was to compare the effectiveness of LM instruments to Hu-Friedy instruments and to assess periodontal treatment outcomes by evaluating plaque index, bleeding index, probing pocket depths, gingival index and clinical attachment level. Secondary goals were to assess and compare clinician comfort levels and to assess the effect of instrument design on static friction and pinch forces required to perform root planing.

MATERIALS AND METHODS

This was a split-mouth randomised clinical trial conducted to compare the non surgical periodontal treatment outcome and clinician's comfort levels using LM ErgoMax over Hu-Friedy hand instruments. All the patients were selected from those attending the Department of Periodontics and Implantology, Vishnu Dental College, Bhimavaram, Andhra Pradesh, India, from September 2021 and completed the entire study by February 2022. The study was approved, and ethical clearance was obtained from the Institutional Ethics Committee with Ref No: (IECVDC/2021/PG01/PI/IVV/49) and also approved under Clinical Trials Registry- India (CTRI/2021/09/036951). Randomisation done by using coin toss method and only the patients were blinded regarding the type of instruments used.

Inclusion criteria:

- Age range of 19-65 years
- Minimum of 20 teeth in the mouth
- Patients who did not receive any periodontal treatment in the last six months to one year

Exclusion criteria:

- Patients with uncontrolled systemic diseases.
- Physically and mentally challenged individuals

Sample size calculation: G-power software version 3.10 was used to calculate the sample size. Sample size of 50 was obtained in the study.

- Input: Tail(s)=Two
  Effect size=0.7857143 [3]
  α err prob=0.05
  Power (1-β err prob)=0.80
  Output: Non centrality parameter δ=3.1746499
  Critical t=2.2009852
  Df=15
  Total sample size=50
  Actual power=0.8234309

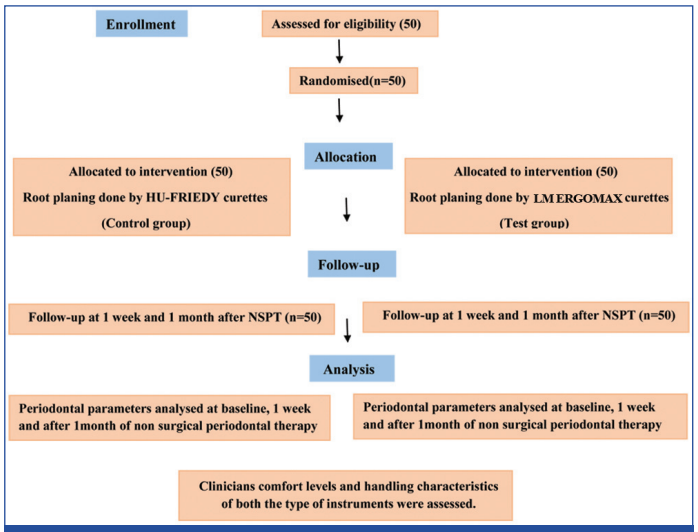
Parameters Assessed

The primary goal of the present study was to compare the effectiveness of LM instruments to Hu-Friedy instruments and to assess periodontal treatment outcomes by evaluating plaque index, bleeding index, probing pocket depths, gingival index and clinical attachment level.

A trained examiner (primary investigator) performed clinical examinations for dental plaque and gingivitis under ambient light at the baseline one week and one month time points. The Löe-Silness (Loe 1963) and Turesky Modification of the Quigley-Hein (Turesky et al., 1970) were used to evaluate dental plaque and gingivitis in the whole mouth [6].

Using the UNC-15 periodontal probe, the sulcus bleeding index (Muhlemann and Son, 1971), Pocket depth measurement and clinical attachment levels were evaluated [6].

Secondary goals were to assess and compare clinician comfort levels and to assess the effect of instrument design on static friction and pinch forces required to perform root planing. Total five operators were included each of five operator performed root planning treatment in 10 patients [Table/Fig-1].



[Table/Fig-1]: Consolidated Standards of Reporting Trials (CONSORT) flowchart.

Study Procedure

Operators checked their latex gloves by pulling them while applying an usual force of 40 Newton (N) and placing a moist thumb pad along the tool's long axis. The lead investigator assessed the thumb-tool interaction during and immediately following the static friction test by noting which dental instruments had the strongest grip and which ones slipped. In the present study, authors evaluated which type of instrument design required higher force during root planing. Pinch force is the hand pressure applied to the instrument handle [7,8]. In the present study, authors asked the operators to rate the comfort levels related to the static friction and pinch forces while using LM and Hu-Friedy instruments.

A questionnaire validated by subject experts, consisting of 10 closed ended questions on comfort levels and on clinical handling characteristics of two different sets of instruments was assessed immediately after the non surgical periodontal therapy [Annexure 1]. Questionnairere is adopted from the study by Mohan Kumar P et al., where they have compared the comfort levels of clinicians and handling characteristics of instruments used for non surgical periodontal therapy [9].

Before starting of the study, standardisation and calibration exercise was performed on the postgraduate students to achieve consistency. Ten postgraduate students trained in professional root planing were included in the pilot study and asked for the best instrument while checking for hand instrument design, handling characteristics and efficiency in calculus removal [10,11].

The responses from the postgraduate students were assessed and Cronbach's alpha value was calculated as a measure of consistency which is 0.9. There was 90% agreement between the postgraduate students in performing the procedure by both sets of instruments. According to the minimum values of Content Validity Ratio (CVR) for different panellist's, a minimum CVR value of 0.99 was considered the cut-off value for 10 panellists. The value obtained for the validity evaluation of the questionnaire is 99% which is well, as in the minimum values of CVR.

STATISTICAL ANALYSIS

The unpaired t-test was used for intergroup assessment, and one-way Analysis of Variance (ANOVA) was used for intergroup

analysis by using Statistical Package for the Social Sciences (SPSS) software. The p-value less than 0.05 was considered significant.

RESULTS

The patients recruited into the present study were aged in between 19-60 years, in which 20 were men (40%) and 30 (60%) were women [Table/Fig-2,3].

Measure	Value in years
Mean	35
Standard deviation	10.36
Median	33
Inter-quartile range	19
Minimum	19
Maximum	60

[Table/Fig-2]: Descriptive statistics for age.

Gender	N (%)
Male	20 (40)
Female	30 (60)

[Table/Fig-3]: Descriptive statistics for gender.

Intergroup analysis was performed between the test and control groups for various periodontal parameters. Statistically significant Gingival Index (GI) scores (0.003) was obtained by comparing the gingival index at one week for the test group and for the control group. The sulcus bleeding index differed significantly (p-value 0.001) between the test and control groups, with mean values of 1.6403 and 1.4148 at one month intervals. At one month, there was statistically significant difference seen (0.001) in probing depths between the test and control groups, with a mean value of 3.1864 for the test group and a mean value of 2.4298 for the control group. At monthly intervals, the test group and control group had a statistically significant (p-value=0.001) difference in clinical attachment level, with mean values of 3.1866 and 2.4298, respectively [Table/Fig-4].

Parameter	Time point	Study groups	Mean	Std. Deviation	p-value
Plaque index	Baseline	Test	4.1359	0.26064	0.29
		Control	4.1867	0.21475	
	1 week	Test	3.4153	0.33756	0.455
		Control	3.4227	0.32162	
	1 month	Test	1.5308	0.25499	0.391
		Control	1.5788	0.29971	
Gingival index	Baseline	Test	1.6522	0.33169	0.251
		Control	1.7268	0.31359	
	1 week	Test	0.8925	0.39842	**0.003**
		Control	0.6413	0.41829	
	1 month	Test	0.4610	0.24009	**0.001**
		Control	0.3176	0.17845	
Sulcus bleeding index	Baseline	Test	3.3159	0.21717	**0.044**
		Control	3.2860	0.18284	
	1 week	Test	2.4407	0.22790	**0.042**
		Control	2.3562	0.17964	
	1 month	Test	1.6403	0.24664	<0.001
		Control	1.4148	0.17620	
Probing depth (in mm)	Baseline	Test	3.9330	0.77600	0.343
		Control	3.7936	0.68240	
	1 week	Test	3.4012	0.44291	0.099
		Control	3.2599	0.40359	
	1 month	Test	3.1864	0.29710	<0.001
		Control	2.4298	0.28064	
Clinical attachment level	Baseline	Test	5.0355	1.17355	<0.001
		Control	3.9815	0.69642	
	1 week	Test	3.4010	0.44463	0.100
		Control	3.2599	0.40359	
	1 month	Test	3.1866	0.31090	<0.001
		Control	2.4298	0.28064	

[Table/Fig-4]: Intergroup comparison of clinical parameters by using unpaired t-test at baseline, one week and one month.

Intergroup analysis revealed highly statistical significance result for evaluation of periodontal probing depth (0.001) at one month interval in both test and control group [Table/Fig-5,6].

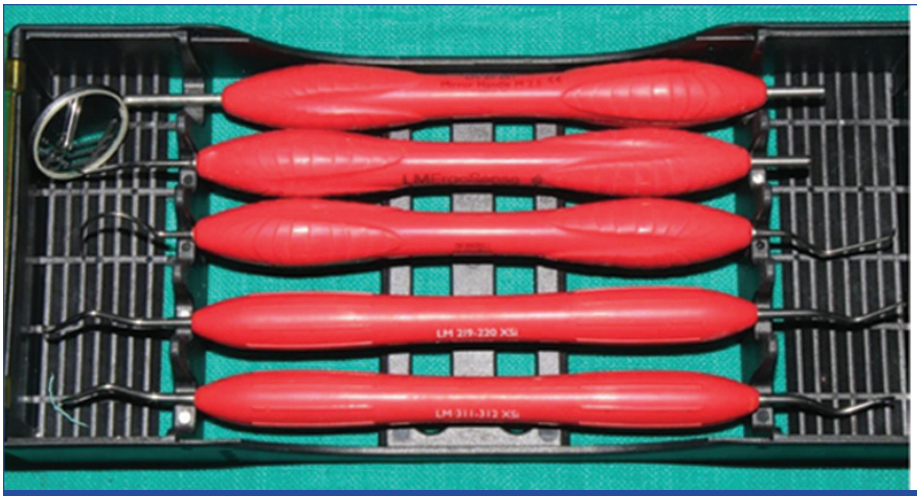
Parameter	Time point	Mean	Std. Deviation	p-value
Plaque index	Baseline	4.1359	0.26064	0.01
	1 week	3.4153	0.33756	
	1 month	1.5308	0.25499	
Gingival index	Baseline	1.6522	0.33169	0.01
	1 week	0.8925	0.39842	
	1 month	0.4610	0.24009	
Clinical attachment level	Baseline	5.0355	1.17355	0.01
	1 week	3.4010	0.44463	
	1 month	3.1866	0.31090	
Probing depth (in mm)	Baseline	3.9330	0.77600	0.01
	1 week	3.4012	0.44291	
	1 month	3.1864	0.29710	
Sulcus bleeding index	Baseline	3.3159	0.21717	0.01
	1 week	2.4407	0.22790	
	1 month	1.6403	0.24664	

[Table/Fig-5]: Comparison of clinical parameters within the test group with change in time.
Repeated measures analysis of variance; p≤0.05 considered statistically significant

Parameter	Time point	Mean	Std. Deviation	p-value
Plaque index	Baseline	4.1867	0.21475	0.01
	1 week	3.4227	0.32162	
	1 month	1.5788	0.29971	
Gingival index	Baseline	1.7268	0.31359	0.01
	1 week	0.6413	0.41829	
	1 month	0.3176	0.17845	
Clinical attachment level	Baseline	3.9815	0.69642	0.01
	1 week	3.2599	0.40359	
	1 month	2.4298	0.28064	
Probing depth (in mm)	Baseline	3.7936	0.68240	0.01
	1 week	3.2599	0.40359	
	1 month	2.4298	0.28064	
Sulcus bleeding index	Baseline	3.2860	0.18284	0.01
	1 week	2.3562	0.17964	
	1 month	1.4148	0.17620	

[Table/Fig-6]: Comparison of clinical parameters within the control group with change in time.
Repeated measures analysis of variance; p≤0.05 considered statistically significant

A questionnaire was used to compare the treatment outcomes, comfort [Table/Fig-7,8], handling characteristics like grip when working [Table/Fig-9,10], treatment satisfaction by the operators, and the cutting efficiency of the Hu-Friedy instruments and LM instruments [Table/Fig-11]. A 60% of the clinicians felt excellent comfort with LM instruments as compared to 40% for Hu-Friedy instruments. An 80% of the clinicians felt that LM instruments provided improvement in friction while working as compared to only 20% clinicians for Hu-Friedy instruments. The coefficient of static friction was higher for a smooth surfaced LM instrument than




[Table/Fig-7]: LM curettes. **[Table/Fig-8]:** Root planning with LM curette. (Images from left to right)


[Table/Fig-9]: Hu-Friedy curettes. **[Table/Fig-10]:** Root planning with Hu-Friedy curette. (Images from left to right)

S. No.	Question	Type of instrument	Frequency	Percentage
1.	How comfortable the clinician felt while performing the treatment with	LM Ergomax: a) 0 b) 1 c) 2 d) 3	Option d)-3 Option c)-2	Option d)-60% Option c)-40%
		Hu-Friedy: a) 0 b) 1 c) 2 d) 3	Option d)-2 Option c)-3	Option c)-60% Option d)-40%
2.	How the clinician rated his treatment outcome levels	LM Ergomax: a) 0 b) 1 c) 2 d) 3	Option c)-5	Option c)-100%
		Hu-Friedy: a) 0 b) 1 c) 2 d) 3	Option c)-5	Option c)-100%
3.	Did you notice a drastic difference in your comfort levels while handling instruments.	Yes	5	(100%)
		No	0	0%
4.	Does the surface texture or characteristics of instruments play a role in instruments grasp. If yes which instrument showed better grasp	LM Ergomax	1	20%
		Hu-Friedy	4	80%
5.	Did you notice any improvement or change in efficiency of instrumentation while working.	LM Ergomax	5	100%
		Hu-Friedy	0	0%
6.	Which instrument provided any change or improvement in friction while working	LM Ergomax	4	80%
		Hu-Friedy	1	20%
7.	Of the following, which instrument design helped you for easy removal of calculus deposits	LM Ergomax	3	60%
		Hu-Friedy	2	40%
8.	Which of the following instruments require additional force for removal of +2 or +3 calculus.	LM Ergomax	3	60%
		Hu-Friedy	2	40%
9.	Does the cutting efficiency of two types of instruments remained same even at the end of the study. If no, which instrument cutting efficiency is reduced.	LM Ergomax	3	60%
		Hu-Friedy	2	40%
10.	Mark the instruments which is more efficient in non surgical periodontal treatment outcome	LM Ergomax	2	40%
		Hu-Friedy	3	60%

[Table/Fig-11]: Questionnaire data.

HuFriedy instruments. Static friction and pinch forces were good for 80% of operators with HuFriedy instruments, whereas 100% of operators were satisfied with LM instruments when used for root planing procedure.

DISCUSSION

The outcome of the present study compared the LM curettes to the Hu-Friedy curettes to assess the instrument's efficiency. When utilising LM curettes, greater tactile sensitivity and complete control were seen, leading in improved ergonomics. A 60% of the clinicians felt excellent comfort with LM instruments as compared to 40% for Hu-Friedy instruments. LM curettes are composed of an extremely durable unique metal alloy, and a protective micro membrane covering improves wear resistance and cuts down on time spent sharpening instruments. These characteristics enhance the clinician's comfort and tactile sensitivity [12,13], whereas, Hu-Friedy instruments designed with True Fit technology to maximise ergonomics and reduce pinch force and its scaler blade is 72% sharper to enable calculus removal with less pressure [14].

According to studies by Hill RW et al., and Schlageter L et al., hand instrumentation curettage generated the smoothest root surface, whereas mechanical instruments, such as the ultrasonic scaler, roughened the root surface [15,16]. In research comparing manual and ultrasonic subgingival debridement, Yan Y et al., discovered no significant change in clinical indicators such as Bleeding on Probing (BOP), Clinical Attachment Loss (CAL) and Probing Depth (PD) [17]. However, in the present investigation, we found statistically significant differences between two types of hand instruments, LM and Hu-Friedy hand instruments.

Cobb CM, realised that hand curettes needed greater skill and time [18]. Several studies have brought the prior technique of removing damaged cementum to render the root surface favourable for soft tissue healing into question. Hand instrumentation for subgingival debridement makes therapy less harsh and more enjoyable for both the patient and the therapist [19-21]. As a result, the importance of hand root planing cannot be overstated. Hand instrumentation has been recommended as the last finishing step in the treatment of periodontitis affected roots following ultrasonic debridement [22]. In the findings of the study conducted by Rempel D et al., demonstrated that dental instrument design affects dentist's experiences of discomfort, thereby use of a lighter instrument with a larger diameter increases clinicians comfort levels [23]. In the present study, LM curettes with their unique handling properties have shown to be ergonomic friendly to the clinicians.

Puglisi R et al., has compared the four different instruments (Gracey curettes-Hu-Friedy, piezoelectric ultrasonic (Satelec®) with No.1S insert, diamond burs 40 µm (Intensiv Perioset®), piezosurgery ultrasonic (Mectron®) with PP1 insert to assess clinical outcome, chair side time at various timelines i.e., one, two, four, eight weeks after treatment. Gracey curettes have shown clinically more effective than diamond burs. The present study is in line with the previous study in terms of probing depths and clinical attachment levels where the statistically significant difference was seen in both the studies. In par with ultrasonic unit, LM curettes with their unique characteristic sharpness have shown to have lessened chair side time for instrumentation [24].

Static friction and pinch forces were good for 80% of operators with Hu-Friedy instruments, whereas 100% of operators were satisfied with LM instruments. As LM curette has large diameter and light weight it requires less pinch force when compared to Hu-Friedy curette. Decreased pinch force led to least chance to hand fatigue and injury risk due to repetitive motions [7,8]. The mean coefficients of static friction by tool material and glove should range from 0.20-0.34 for effective scaling and root planing. The mean safety margin of pinch forces used during scaling and root planing will be 4.88 N±1.58 N for inexperienced and 3.35 N±0.55 N for experienced dentists [7,8].

Root planing is now utilised to aid in the removal of subgingival plaque rather than to emphasise the purposeful removal of cementum. As a result, the goal of the present study is to compare the efficacy of LM curettes with Hu-Friedy curettes in the non surgical treatment of periodontitis using a split-mouth design after one week and one month.

Limitation(s)

The study limitations include less sample size and the number of operators included in the study is minimal.

CONCLUSION(S)

The present study findings demonstrate that LM instruments have better handling features and cutting efficiency of Hu-Friedy instruments is better initially and reduced of its continuous usage. Although, there is no significant difference in plaque index, gingival index, probing depth reduction, sulcus bleeding index, or clinical attachment level with both set of instruments.

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[ANNEXURE 1]

Questionnaire on Comparison and Assessment of Comfort Levels with Two Different Sets of Hand Instruments Used in Non Surgical Periodontal Therapy

Comfort levels: 0- No difference 1-Fairly 2-Good 3- Excellent

1. How comfortable the clinician felt while performing the treatment with –
   LM Ergomax: a) 0 b) 1 c) 2 d) 3
   Hu-Friedy: a) 0 b) 1 c) 2 d) 3
2. How the clinician rated his treatment outcome levels-
   LM ERGOMAX: a) 0 b) 1 c) 2 d) 3
   Hu-friedy: a) 0 b) 1 c) 2 d) 3
3. Did you notice a drastic difference in your comfort levels while handling instruments.
   a) Yes
   b) No
4. Does the surface texture or characteristics of instruments played a role in instruments grasp. If yes which instrument showed better grasp characteristics.
   a) Hu-Friedy b) LM ErgoMax
5. Did you notice any improvement or change in efficiency of instrumentation while working.
   a) LM ErgoMax
   b) Hu-Friedy
6. Which instrument provided any change or improvement in friction while working?
   a) LM ErgoMax
   b) Hu-Friedy
7. Of the following, which instrument design helped you for easy removal of calculus deposits.
   a) Hu-Friedy b) LM ErgoMax
8. Which of the following Instruments require additional force for removal of +2 or +3 calculus.
   a) Hu-Friedy b) LM ErgoMax
9. Does the cutting efficiency of two types of instruments remained same even at the end of the study. If no, which instrument cutting efficiency is reduced.
   a) Hu-Friedy b) LM ErgoMax
10. Mark the instruments which is more efficient in non surgical periodontal treatment outcome
    a) Hu-Friedy b) LM ErgoMax