

An *in vivo* Study Comparing the Characteristics of Esthetic, Self-ligating and Metallic Brackets

Shashank Sharad Gaikwad, Ashwin Deshpande, Sachin S Doshi, Amol Mhatre, Manish Sonawane

ABSTRACT

The aim of this *in vivo* study was to compare the characteristics of esthetic, self-ligating brackets (SLBs) and metallic brackets, to find bracket bond failures with SLBs and manually ligating brackets (MLBs), bracket breakages with SLBs and MLBs and staining with the SLBs. Seven patients were compared in each group. Standard light curing bonding methods were used in both the groups. Chairside time saving, appliance efficiency and bracket bond failures were compared among the groups whereas staining was observed with the SLBs. Appliance efficiency was evaluated by peer assessment rating (PAR) scores. Results showed significant chairside time being saved in SLBs, whereas the appliance efficiency was not significant. Bond failures were found only in SLBs as well as breakages along with staining. Henceforth, we could conclude that though SLBs had advantage of saving chairside time but also had disadvantage of losing more time with bond failures.

Materials and methods: Two groups of seven patients were created: First group (seven patients) received treatment with OPAL SLBs (Ultradent products, USA) and second group (seven patients) received treatment with MLBs manually ligating metal brackets (Nu-Edge, TP Orthodontics, USA). Case selection was done for both the groups. Bonding procedure was done in both groups in which primer application was done on both tooth surface and bracket base in case of OPAL SLB's while in case of MLBs, primer was applied only on tooth surface. A questionnaire was evaluated for knowing patients comfort.

Results: Comparison of mean values of PAR scores in both the groups for pre-, post-treatment and in the reduction of PAR scores was done.

It showed that SLBs were 6.5 times quicker than the MLBs during the archwire changes, thus saving considerable chairside time. Treatment outcome after 120 days, in both groups was almost the same. The SLBs had many bracket bond failures while MLBs had none. SLBs had other shortcomings, such as bracket breakage, staining, cap opening, etc.

Keywords: Self-ligating brackets, Manually ligating brackets, PAR test.

How to cite this article: Gaikwad SS, Deshpande A, Doshi SS, Mhatre A, Sonawane M. An *in vivo* Study Comparing the Characteristics of Esthetic, Self-ligating and Metallic Brackets. *J Contemp Dent* 2012;2(3):73-77.

Source of support: Nil

Conflict of interest: None declared

INTRODUCTION

Evolution of brackets is a field involving constant innovations with the aim of pleasing both the orthodontists and patients. New brackets are constantly being developed to make the treatment a more pleasing experience for the patient. Introduction of self-ligating brackets (SLBs) in 1935

by Dr Jacob Stolzenberg left many practitioners unfamiliar with the advantages of these revolutionary SLBs. The mechanism of ligation in these revolutionary brackets was in stark contrast to the traditional approach of tying steel ligatures around each bracket. Treatment was considerably more comfortable with shorter office visits and shorter overall treatment time. Perhaps because Dr Stolzenberg was ahead of his time, the concept of SLBs fell more or less into obscurity until the early 1970s.¹ In 1971, Dr Jim Wildman of Eugene, Oregon, developed the Edgelok bracket.² And in the process many a SLBs^{1,3-6} followed suite.

OPAL SLBs (Ultradent, UK) fabricated with glass filled (nickel free) polycarbonate were introduced in year 2004. To our knowledge, no study was carried out to evaluate this type of new SLB. Hence, the need for this study was felt.

Our study was, therefore, aimed at evaluating the chairside time saved, patients' comfort, appliance efficiency, bracket bond failures, breakages and bracket staining in the Opal SLBs and comparing them with the conventional standard metal brackets of MBT system (TP Orthodontics, UK).

AIMS AND OBJECTIVES

Evaluate and compare:

1. Chairside time savings with SLBs and manually ligating brackets (MLBs)
2. Appliance efficiency in leveling and aligning of SLBs and MLBs
3. Patients' comfort with SLBs and MLBs
4. Bracket bond failures with SLBs and MLBs
5. Bracket breakages with SLBs and MLBs
6. Staining with the SLBs.

MATERIALS AND METHODS

All cases were selected from the Department of Orthodontics, PMNM Dental College, Bagalkot, Karnataka. Out of 20 cases, six cases (three in each group) were excluded from the study for discontinuation of treatment by the patients. This reduced the overall number to 14 cases (seven in each group).

Thus, 14 patients were included in the study. Two groups of seven patients were created: First group (seven patients) received treatment with OPAL SLB's (Ultradent products, USA; Fig. 1A) and second group (seven patients) received treatment with MLB's manually ligating metal brackets (Nu-Edge, TP Orthodontics, USA; Fig. 1B).

Case selection criteria were done for both the groups:

- Age of 15 to 25 years
- A minimum score of 10 on peer assessment rating (PAR)
- No history of trauma to the orofacial region
- No history of orthognathic surgery and/or previous orthodontic treatment
- No known congenital craniofacial anomaly
- Treatment plan required no extractions.

Bonding procedure for the conventional MLBs involved (Fig. 2):

- 1st step: Etching
- 2nd step: Primer application on tooth surfaces only
- 3rd step: Adhesive on bracket base.

Bonding procedure for the OPAL SLBs involved (Figs 3A to C):

- 1st step: Etching
- 2nd step: Primer application on both tooth surface and bracket base
- 3rd step: Adhesive on bracket base.

Various parameters were evaluated as below:

1. *Chairside time evaluation:* Only one operator, operated, having no prior experience in the usage of both the bracket systems. In both the groups, the time required to remove and replace the archwire in either the maxillary and mandibular arch from the right second premolar to the left second premolar was noted. The time recorded was solely related to the removal or replacement of the ligature tie and did not involve manipulation of the archwire. The time was recorded using a stopwatch which was recorded by a trained staff. The operator announced the start and completion of upper and lower archwire removal and placement and

the time taken was noted. This time data was divided by the number of brackets present to calculate the average time taken for each bracket.

2. *Appliance efficiency (in leveling and aligning):* The PAR scores were included as a matching criterion in this study for two reasons. Firstly, this score has a relationship with treatment complexity and secondly, this measure can be used to record the severity of malocclusion at any stage of treatment and thus provide a measure of quality of treatment.^{7,8} These scores were measured using PAR ruler. The PAR score was calculated prior to start of treatment on the study models of each patient. The differences between the scores were used to evaluate the efficiency of both the groups.
3. *Bracket bond failures:* Number of bracket bond failures in both groups was noted. Bond failures at the time of archwire placement and due to occlusal prematurities were not counted.
4. *Breakage of the brackets:* Breakages in the bracket wings, cap was evaluated in comparison with the ligating metal brackets.
5. *Staining of the SLBs:* The change in the color of the brackets was evaluated only in SLB group.

Questionnaire was used to evaluate patient's comfort:

- Did the brackets cause discomfort or irritation to you?
- Did you feel embarrassing or uncomfortable to sport the braces in your mouth at social places?
- Did your friends easily notice the braces in your mouth?
- When your wires were changed did you feel any pain to your teeth after the appointment?
- Did you find that tooth brushing and oral hygiene was a greater confront?



Fig. 1A: Opal self-ligation brackets (Ultradent products, USA)

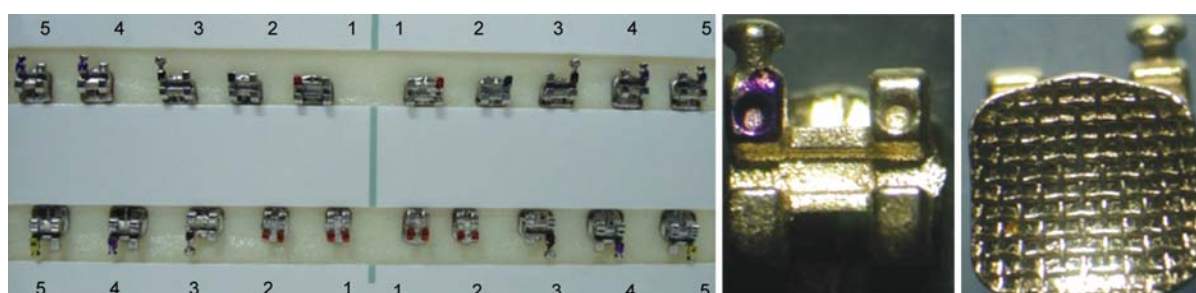


Fig. 1B: Manually ligating brackets (Nu-Edge, TP orthodontics, USA)

- Was your chairside appointment long or short?

Opal bracket cap opening: A gentle insertion of 'Opal Key' bracket opening instrument into the space between bracket base and closed bracket cap and rotation of the instrument handle lifts opens the cap (Fig. 4).

DISCUSSION AND RESULTS

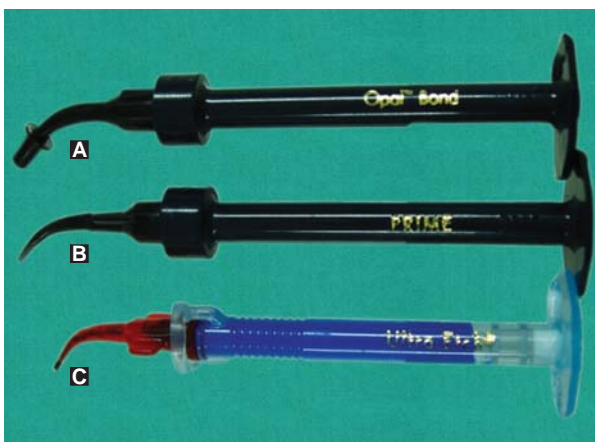
A total of seven patients were examined in both the groups (SLB and MLB), for comparing the chairside time saved by the operator, comparing the bracket bond failures in both the groups, comparing the breakages with the wings and cap of the brackets and observe changes in the color of the brackets for staining.

The results of various parameters are presented as follows:

1. *Chairside time saving for archwire changes:* On placement of archwires it was found that SLBs was nearly (8.92) 9-fold less compared to the MLBs while on removal of archwires it was found that SLBs required only one-third the time taken by MLBs. It was found that overall procedure took 6.5 times less with SLBs (Graph 1).



Fig. 2: Orthosource phosphoric acid etchant (37%), python sealant and light cure composite paste



Figs 3A to C: (A) Opal bond, (B) Opal prime and (C) Opal ultra etch

These findings are in agreement with the studies done by Hanson, Damon, Majjer and Smith.^{3,5,9}

2. *Appliance efficiency (in leveling and aligning):* The mean and SD were calculated in both the groups for the pre- [mean: 22.8571 ± 7.0102 (SLB) and 19.0000 ± 5.0662 (MLB)] and post-treatment [mean: 9.4286 ± 4.1173 (SLB) and 8.0000 ± 2.4495 (MLB)] percentage reductions in PAR scores after a period of 120 days of the leveling and aligning stage. Paired Students t-test was used at 0.01% level to determine statistical significance of percentage reductions in PAR scores in SLB and MLB.

An unpaired Students t-test was done to find the statistical significant difference between the groups. The pretreatment ($t = 1.1799$ and $p = 0.4455$) as well as percentage reduction in PAR scores ($t = 1.0251$ and $p = 0.3255$) of SLB and MLB groups at 5% level revealed no statistically difference between both the groups (Graph 2).

Our findings are in agreement with Dobrin who has shown that conventional plastic brackets have poor efficiency due to their deformation.¹⁰ Dobrin showed conventional plastic brackets have poor efficiency due to their deformation. But they are not in concurrence with the studies by Damon, Eberting, Straja and Tuncay and Harradine.

The efficiency of metal SLBs is better than the plastic SLBs as the latter could fail:

- Rigidity,
 - Wear resistance of the tab on the cap which secures the wire into slot, and
 - Secure locking of the cap into its right place.
3. *Patients comfort:* The 6-question survey was done. Unpaired Student's t-test (Graphs 3 and 4).

- a. Did the brackets cause discomfort or irritation to you?

A higher percentage of discomfort was noticed in MLB group than in SLB group.



Fig. 4: Opal bracket cap opening

Not significant statistically. It suggests that equally comfortable to the patients, similar findings were reported by Eberting, Straja and Tuncay.¹¹

- b. Did you feel embarrassing or uncomfortable to sport the braces in your mouth at social places?

Equal response was seen, equally less embarrassing contrary to general perception that ‘a patient will be more uncomfortable wearing metal brackets than esthetic brackets.’ This was so MLB group were esthetically not much concerned and were mentally prepared to wear such brackets.

- c. Did your friends easily notice the braces in your mouth? MLB group perceived their brackets visible whereas 57.14% in SLB group felt so, statistically significant ($t = 2.8284$ and $p = 0.0152$). The obvious rationale was MLBs having metallic color whereas SLBs having translucency hindered visibility.
- d. When your wires were changed did you feel any pain to your teeth after the appointment?

Archwire changes elicited pain in majority of patients in MLB group (85.71%) and to a lesser percentage in the SLB group (57.1%).

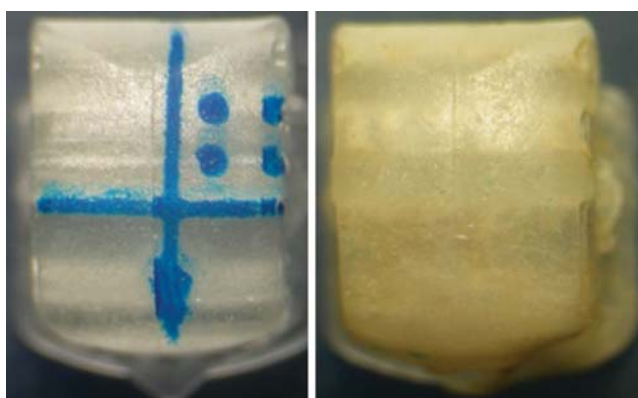


Fig. 5: Opal SLBs, prior to usage (left), after 120 days of treatment (right)

Not statistically significant ($t = 1.1547$ and $p = 0.2707$), indicating both the bracket systems cause pain on engagement of archwire.

This finding compares favorably with the observations of Eberting, Straja and Tuncay.¹¹

- e. Did you find that tooth brushing and oral hygiene was a greater comfort?

A total of 85.71% in MLB group were comfortable whereas 28.57% in SLB group were at ease in maintaining the oral hygiene, statistically significant ($t = -2.4495$ and $p = 0.0306$).

The difference could be due to the fact that SLBs are large, have complex design and made of color absorbing plastic.

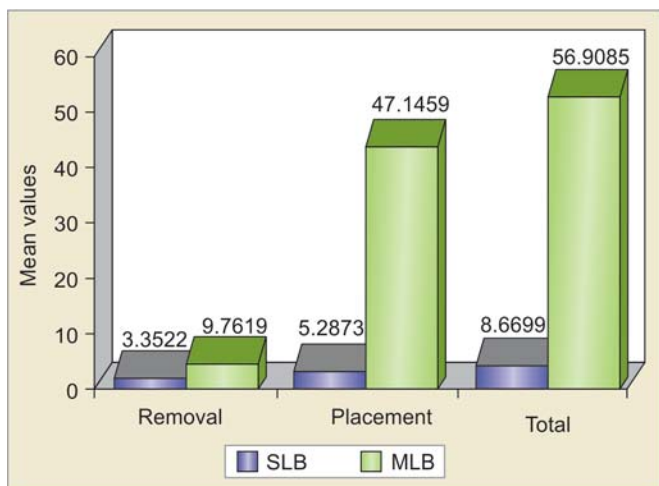
- f. Was your chairside appointment long or short? SLB group felt shorter appointment while MLB group thought it was longer, statistically highly significant ($t = -2.4495$ and $p = 0.0306$).

A 6.5-fold loss was seen in the chairside time for the MLB group.

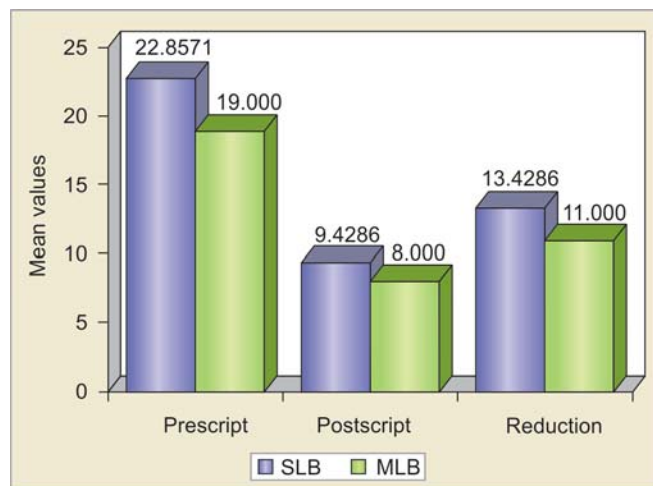
- 4. *Bracket bond failures:* No statistical analysis performed was performed. No bond failures were seen in MLB group while 22 bond failures in SLB group were seen. Failures were at the bracket and resin interface. Poor strength was seen due to:

- a. Inability of the primer to bond chemically with the base
- b. Poor design of the bracket base which does not provide sufficient mechanical locking for the adhesive.

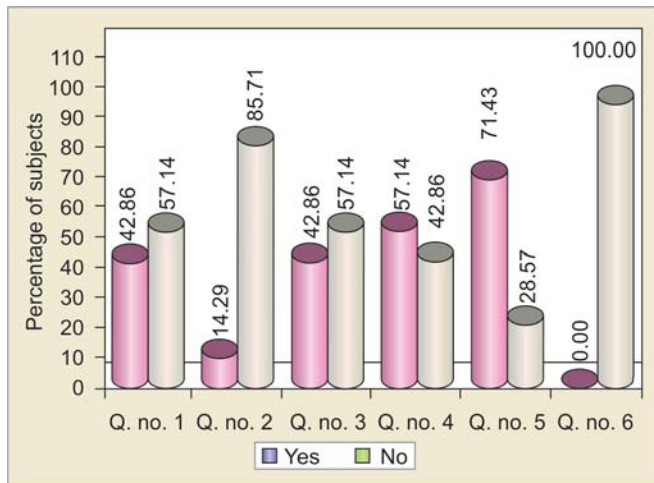
- 5. *Breakage of bracket:* No statistical analysis—no bracket breakage in the MLB group. Single cap breakage was noted in SLB group, which could be of significance as this is one in 138 brackets used. The inferior fracture resistances of plastic brackets could have lead for single cap breakage.



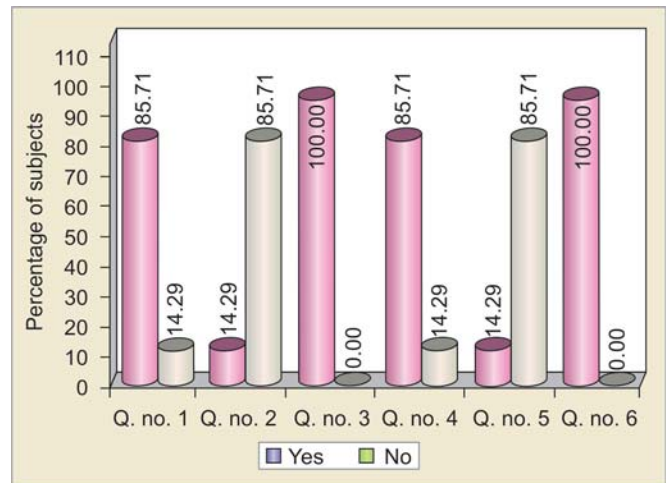
Graph 1: Comparison of both the groups with respect to chairside time saving in removal, placement and its total



Graph 2: Comparison of mean values of PAR scores in both the groups for pre-, post-treatment and in the reduction of PAR scores



Graph 3: Percentage distribution of response of study subjects according to different questions in SLB



Graph 4: Percentage distribution of response of study subjects according to different questions in MLB

6. *Staining of the brackets:* Color change was seen from translucent white to opalescent yellow in all the SLBs. Due to poor wear resistance of plastic bracket materials (Zinelis), after the cap is closed there is some space between the slot and the cap. The food debris and other staining elements trapped in this space (Fig. 5).

CONCLUSION

The following conclusions were drawn from the study:

1. SLBs were 6.5 times quicker than the MLBs during the archwire changes, thus saving considerable chairside time.
2. Treatment outcome after 120 days, in both groups was almost the same.
3. The SLBs had many bracket bond failures while MLBs had none.
4. SLBs had other shortcomings, such as bracket breakage, staining, cap opening, etc.

REFERENCES

1. Berger JL. Self-ligation in the year 2000. *J Clin Orthod* 2000;34:74-81.
2. Wildman AJ, et al. Round table: The Edgelok bracket. *J Clin Orthod* 1972;6:613-23.
3. Hanson GH. The SPEED system: A report on the development of a new edgewise appliance. *Am J Orthod* 1980;78:243-65.
4. Heiser W. Time: A new orthodontic philosophy. *J Clin Orthod* 1998;32:44-53.
5. Damon DH. The Damon low friction bracket: A biologically compatible straight wire system. *J Clin Orthod* 1998;35:670-80.
6. Damon DH. The rationale, evolution and clinical application of the self-ligating bracket. *Clin Orthod Res* 1998;1:52-61.
7. Richmond S, et al. The development of the PAR index [peer assessment rating]: Reliability and validity. *Eur J Orthod* 1992;14:125-40.

8. Richmond S, et al. The PAR index [peer assessment rating]: Methods to determine the outcome of orthodontic treatment in terms of improvement and standards. *Eur J Orthod* 1992;14:180-87.
9. Maijer R, Smith DC. Time savings with self-ligating brackets. *J Clin Orthod* 1990;24:29-31.
10. Dobrin RJ, Kamel IL, Musich DR. Load deformation characteristics of polycarbonate orthodontic brackets. *Am J Orthod* 1975;67:24-33.
11. Eberting JJ, Straja SR, Tuncay OC. Treatment time, outcome and patient satisfaction comparisons of Damon and conventional brackets. *Clin Orthod Res* 2001;4:228-34.

ABOUT THE AUTHORS

Shashank Sharad Gaiwad (Corresponding Author)

Senior Lecturer, Department of Orthodontics, MGM Dental College and Hospital, Navi Mumbai, Maharashtra, India, e-mail: drshashankgaiwad@yahoo.co.in

Ashwin Deshpande

Reader, Hazaribag College of Dental Sciences and Hospital, Hazaribag Jharkhand, India

Sachin S Doshi

Senior Lecturer, Department of Orthodontics, MGM Dental College and Hospital, Navi Mumbai, Maharashtra, India

Amol Mhatre

Senior Lecturer, Department of Orthodontics, MGM Dental College and Hospital, Navi Mumbai, Maharashtra, India

Manish Sonawane

Senior Lecturer, Department of Orthodontics, MGM Dental College and Hospital, Navi Mumbai, Maharashtra, India