Research Article

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Comparative Evaluation of Arch Dimensional Changes Between Damon Q and MBT Brackets: An In-Vitro Study

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ABSTRACT

Background: The efficiency of Damon Q bracket systems for arch width expansion have not been proved in clinical trials to date. Therefore, the purpose of the study was to compare and evaluate the maxillary and mandibular arch dimensional changes with Damon Q and MBT brackets, both in extraction and non-extraction cases.

Materials and Methods: Pre-treatment and post-treatment study models of 44 patients who have undergone orthodontic treatment were selected. The study samples were divided into four groups with 11 patients each. Group A, B, C and D as first premolar extractions with Damon Q Brackets, non-extraction with Damon Q Brackets, first premolar extractions with MBT Brackets and non-extraction with MBT Brackets respectively. The inter-molar width (IMW), inter-premolar width (IPW) and inter-canine width (ICW) were measured using a digital caliper.

Results: The study showed an increase in ICW in both arches of Group A and B. Also there was a significant increase in maxillary IPW in these groups. When comparing mandibular IPW, a significant decrease in Group A and an increase in Group B was observed. There was significant increase in IMW in both the arches of Group A and B with increment in IMW comparatively less in Group B. The study showed an increase in mandibular ICW in Group C and D. The maxillary and mandibular IPW and IMW in Group D increased whereas there was decrease in Group C

Conclusion: There was expansion of arches in Groups A, B, D whereas narrowing of arches was seen in Group C. The expansion achieved can be put in descending order from Damon Q non extraction, Damon Q extraction, MBT non extraction and MBT extraction.

Keywords: Damon Q Brackets; MBT Brackets; Self-Ligating; Arch Expansion.

INTRODUCTION

Incorporating a self-ligating mechanism into the design of an orthodontic bracket is not a new concept but it is only recently that the many technological difficulties associated with efficient design and large-scale manufacture of these brackets have been largely overcome. This has meant that a number of more robust and reliable self ligating brackets are now available to the orthodontist and amongst these the Damon System is one of the most popular. There are a number of probable reasons for this pre-eminence, but the

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simplicity and high quality engineering of the core bracket design, availability of four subtly different bracket types and utilization of a passive self ligating slot in combination with high technology arch wires collectively make this an attractive appliance to use.

The Damon self-ligating bracket was developed as an integral component of a low-friction appliance. Damon SL in 1996, Damon 2 in 2000, Damon 3 in 2004, Damon 3MX in 2005 and Damon Q in 2009 were developed based on the theory that "Low Friction and Light Forces Produced More Biologically Stable Results" by Dwight Damon in 1990's. The low-force and low-friction environment provided by the Damon appliance offers considerable advantages over those with conventional ligation. These include greater patient comfort during treatment, fewer visits to the Orthodontist, shorter overall treatment time, less need for extractions and better outcomes in terms of both occlusal and facial esthetics.

The Damon passive self- ligating system introduced broader arch wires and a passive clip with the claim of posterior expansion with bodily movement or minimal tipping of the teeth. Moreover, despite a dearth of supporting evidence, passive self-ligating appliances have been claimed to lend themselves to non-extraction based treatment. The possibility of non-extraction treatment with these systems relates to this potential for transverse expansion prompting the advancement of self-ligating brackets as an alternative to more conventional approaches involving active expansion with auxiliaries such as rapid palatal expanders.

The available evidence on the efficiency of self-ligating brackets derives from a limited number of prospective and randomized clinical trials. Some have indicated no differences in arch dimension1 and some have shown differences between self-ligating and conventional appliances.2 However there have not been many studies to provide a clear comparison between the Damon Q bracket systems and arch width expansion. Buccal expansion in the arch is highly unpredictable and can be influenced by various factors including anatomy of the underlying structures, inclination of the molars and architecture of the oral musculature.3

Therefore, the purpose of the study was to compare and evaluate the maxillary and mandibular arch dimensional changes with Damon Q and MBT brackets, both in extraction and non-extraction cases.

AIMS AND OBJECTIVES

Subjects and Methods:

Pre-treatment and post treatment study models of 44 patients who have undergone orthodontic treatment were selected.

Method of collection of data

- The sample size consist of pre-treatment and post treatment study models of 44 patients.

- Group A consisted of pre-treatment and post treatment study models of 11 patients who have undergone 4 first premolar extractions as part of orthodontic treatment and treated with Ormco Damon Q Brackets.

- Group B consisted of pre-treatment and post treatment study models of 11 patients who have undergone non extraction treatment in both arches with Ormco Damon Q Brackets.

- Group C consisted of pre-treatment and post treatment study models of 11 patients who have undergone 4 first premolar extractions as part of orthodontic treatment and treated with Conventional Ligating Brackets (MBT).

- Group D consisted of pre-treatment and post treatment study models of 11 patients who have undergone non extraction treatment in both arches with Conventional Ligating Brackets (MBT).

The following transverse dimensions were recorded with digital caliper.

- Inter canine width: Measured from the cusp tip of the canine on one side to the cusp tip of the canine on the other side.

- Inter premolar width: Measured from the buccal cusp tip of the second premolar on one side to the buccal cusp tip of the second premolar on the other side

• Inter molar width: Measured from the mesio-buccal cusp of the first molar on one side to the mesio-buccal cusp of the first molar on the other side.

Inclusion criteria:

All casts must be in good condition.
All permanent teeth should be present.
All second molars must be present and should be in alignment.
All cases should have received orthodontic treatment using DAMON Q or MBT brackets.
At the end of treatment, all cases should be considered to be well treated i.e. displaying a class I canine and molar relation.

Exclusion criteria

Patients who were treated with appliances specially designed to increase maxillary and mandibular arch widths like palatal expanders etc.
Any gross dental anomalies (or) congenitally missing incisors
Broken models
Materials used
Digital caliper (Rabbit Force, Japan)
Pre-treatment and post treatment casts
A black 2H automatic pencil with a 0.5 mm tip

Procedure

A black 2H automatic pencil with a 0.5 mm tip was used to mark the mesio-buccal cusps of first molars, the buccal cusp tips of the second premolars and the cusp tips of the canines on the maxillary and mandibular arches of the pre-treatment and post treatment study models. In case of wear, estimated cusp tips were taken. With an electronic digital caliper (rabbit force, japan) inter molar, inter premolar, and inter canine widths were measured. As a result of treatment, the changes in measurement of the arch width between pre-treatment and post-treatment casts were recorded. The arches were viewed from above and the caliper was placed parallel to the occlusal plane to record the measurements.

Statistical analysis applied:

SPSS (IBM version 23) was used for statistical analysis

Statistical Analysis : Descriptive Statistics.

Descriptive statistics includes mean and standard deviation. Inferential statistics included one way ANOVA followed by post-hoc tukeys test. The level of significance was set at 0.05 at 95% confidence interval.

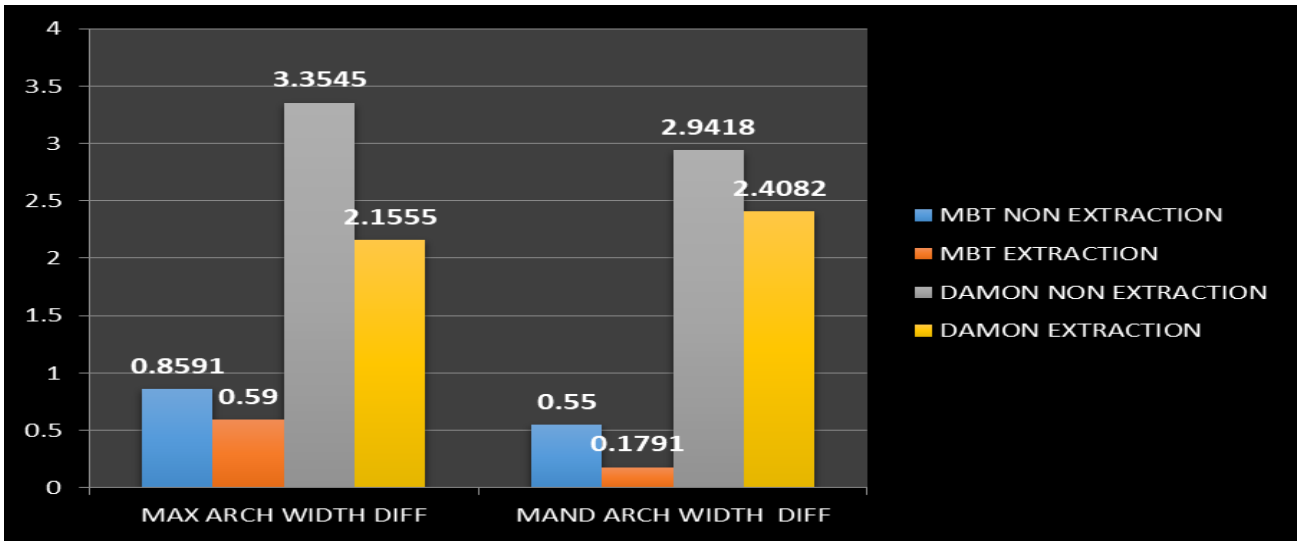
RESULTS

All the pre-treatment and post-treatment cast arch widths were measured at the level of canines, the second premolars and the first molars buccal cusp tips. The amount of crowding in pre-treatment maxillary arches was calculated using the Arch Perimeter model analysis and Careys analysis in mandibular arch. Mean Maxillary crowding (mm) in Damon Q non extraction cases was found to be 3.12 mm and 3.35 mm in mandibular arch. Mean Maxillary crowding (mm) in MBT non extraction cases was found to be 2.02 mm and 2.23 mm in mandibular arch. Mean maxillary crowding in Damon Q extraction cases was found to be 6.35 mm and 9.12 mm in mandibular arch. Mean maxillary crowding in MBT extraction cases was found to be 5.62 mm and 7.01 mm in mandibular arch. The comparison of maxillary and mandibular IC arch width in MBT and Damon Q groups yielded statistically highly significant increment in IC arch widths. The maximum increase in IC width was found in Damon Q non extraction group and the least was noted with MBT extraction group (Table 1, graph 1). In maxillary arch, a significant increase in IP width of Damon Q groups and MBT non extraction group was noted whereas in MBT extraction group there is a decrease of -2.0800 in mean IP width. In mandibular arch, IP width increases in non extraction cases of Damon Q and MBT groups. And a decrease in IP width in extraction cases of Damon Q and MBT groups (Table 2, Graph 2).

The IM width in maxillary and mandibular arch of DAMON Q groups and MBT non extraction group shows significant increase with P value of 0.000 but a significant decrease was observed in MBT extraction cases in both the arches. (Table 3, Graph 3).

Table 1: Comparison of maxillary and mandibular arch width changes in canine region in MBT and Damon Q cases.

IC		Mean	Standard deviation	F	P value
Max arch width diff	MBT Non extraction	0.8591	0.64034	12.676	0.000 (H.S)
	MBT extraction	0.5900	0.79682		
	Damon Non extraction	3.3545	1.54947		
	Damon extraction	2.1555	1.48258		
Mand arch width diff	MBT Non extraction	0.5500	0.63873	44.039	0.000 (H.S)
	MBT extraction	0.1791	0.23708		
	Damon Non extraction	2.9418	0.94395		
	Damon extraction	2.4082	0.70208		

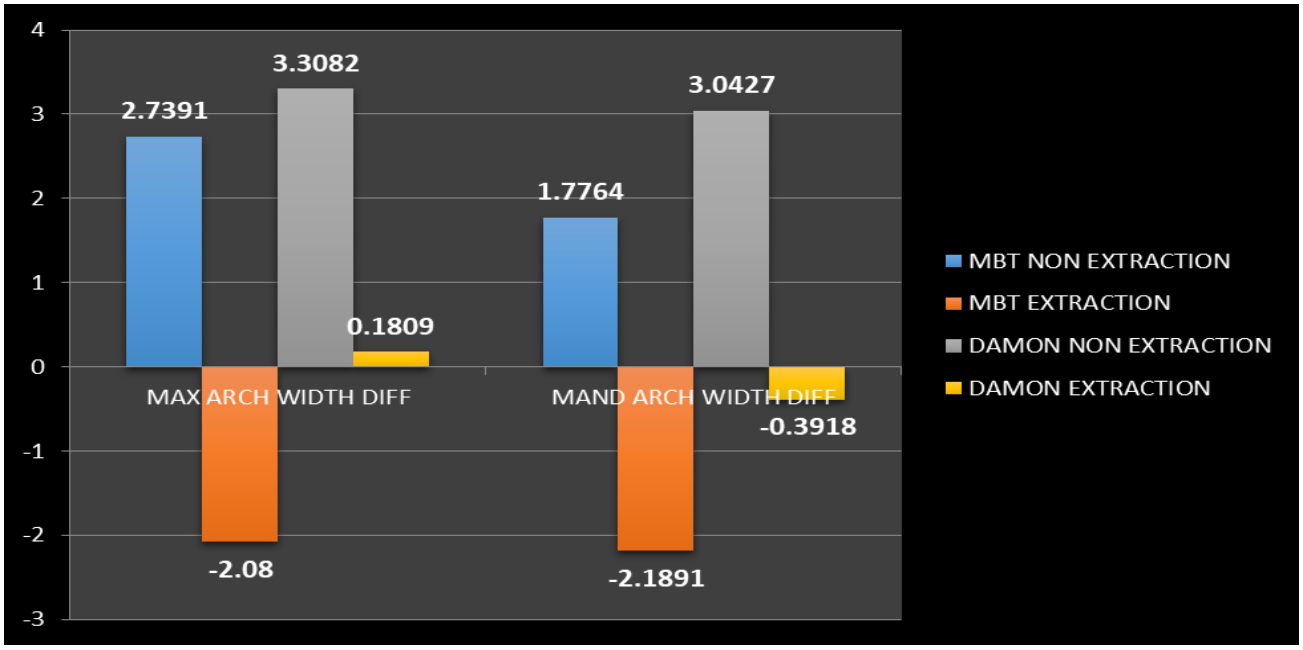


Graph 1. Comparison of mean inter-canine arch width difference in maxillary and mandibular arch in DAMON Q and MBT.

Table 2: Comparison of maxillary and mandibular arch width changes in premolar region in MBT and Damon Q cases.

IP		Mean	Standard deviation	F	P value
Max arch width diff	MBT Non extraction	2.7391	0.67809	21.518	0.000 (H.S)
	MBT extraction	-2.0800	1.44719		
	Damon Non extraction	3.3082	2.63107		
	Damon extraction	0.1809	1.77077		
Mand arch width diff	MBT Non extraction	1.7764	1.38081	24.181	0.000 (H.S)

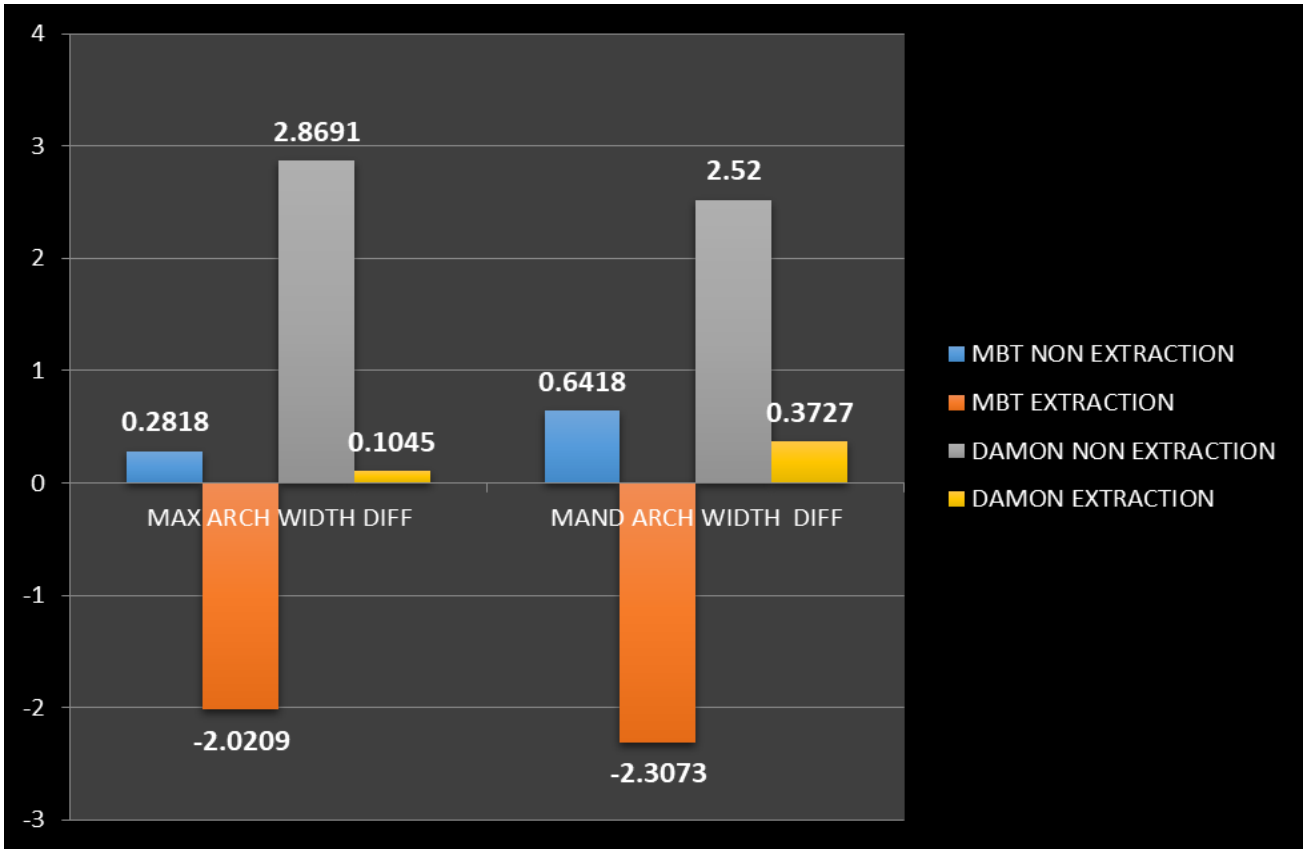
	MBT extraction	-2.1891	1.66139		
	Damon Non extraction	3.0427	1.80856		
	Damon extraction	-0.3918	1.35345		



Graph 2. Comparison of mean inter-premolar arch width difference in maxillary and mandibular arch in DAMON Q and MBT.

Table 3: Comparison of maxillary and mandibular arch width changes in molar region in MBT and Damon Q cases.

IM		Mean	Standard deviation	F	P value
Max arch width diff	MBT Non extraction	0.2818	0.59160	24.829	0.000 (H.S)
	MBT extraction	-2.0209	1.66172		
	Damon Non extraction	2.8691	1.91810		
	Damon extraction	0.1045	0.55947		
Mand arch width diff	MBT Non extraction	0.6418	0.93825	18.443	0.000 (H.S)
	MBT extraction	-2.3073	1.58611		
	Damon Non extraction	2.5200	1.61371		
	Damon extraction	0.0327	1.85889		



Graph 3: Comparison of Mean inter-molar arch width difference in maxillary and mandibular arch in DAMON Q and MBT.

DISCUSSION

Pleasant physical appearance is the outmost important factor for a person and among physical appearance, face is the key. In facial esthetics the balance between the hard tissue and soft tissue plays a major role. Currently, a non-extraction approach is increasingly advocated to be the aim of orthodontic treatment when possible. The reasons for this are partly patient driven because of patient's unwillingness for extraction of sound teeth and partly because of the belief by some that extracting premolars leads to poor esthetic results through creating larger buccal corridors from constriction of the dental arches.

Self-ligating brackets were introduced in this specialty in its first form some decades ago. Nonetheless, in the past 2 decades, there has been a boost in the manufacturing and release of self-ligating appliances with active or passive ligation modes. The basic advantages of these brackets involve the elimination of certain utilities or materials such as elastomeric modules along with the process or tools associated with their application. The low-friction system produced significant increases in the transverse dentoalveolar width and the perimeter of the maxillary arch during the levelling and aligning phases of treatment.6 According to Birnie, Damon divulged his theory that by using SLB with low friction and light forces more stable biological results could be produced. The Damon SLB system claims that post-treatment computed tomography images show transverse arch development and normal alveolar bone on buccal surface. Low friction and low force are purported to be good to physiologically rebuild the alveolar bone.

The Damon self-ligating bracket was developed as an integral component of a low-friction appliance. It has been suggested that the low-level friction associated with this bracket encourages more rapid levelling and alignment, allowing longer appointment intervals and reduced overall treatment time. The self-ligating bracket systems are advantageous in that they do not promote poor oral hygiene, as with elastomeric ties, and eliminate

any chance of soft tissue laceration to both the patient and the orthodontist from the use of stainless steel tie wires.12, 14, 15

The assessment of the data for the upper inter-canine widths reveals an increase in all treatment groups. This increase in inter-canine width in the upper and lower arch after orthodontic treatment is in agreement with findings in previous studies.5, 13 The increase seen in the inter canine region in extraction group is probably due to the minor lateral movement that occurs as the canines moved distally into the extraction space of the premolars during retraction which is considered to be the broader part of the arch.

In IP region there is decrease in arch width in MBT extraction cases in both the arches and Damon Q extraction cases in mandibular arches. There is a slight increase in IP width in Damon Q extraction cases in maxillary arch. In IM region there is decrease in arch width in MBT extraction cases in both the arches and arch width is slightly increased in Damon Q extraction cases.

Through this study, we have concluded that arch dimensional changes with both Damon Q and MBT can be differentiated. Significant changes occurred in the premolar region with Damon Q brackets in the second premolar region in non-extraction cases when compared to MBT non extraction cases. The reasons for relatively large dimensional increases in our study might relate to the use of Damon Q arch wires, whereas medium form wires were used in MBT cases. Damon Q wires have a broad arch shape, particularly in the buccal segments, and could have contributed to the amount of expansion reported. Slightly greater amounts of inter-molar and inter premolar expansion were noted with the Damon Q system when compared to the MBT system.1,4,11

The results of this study suggest that there is no evidence that bracket selection plays a role in the development of dental variations during treatment, hence the lack of difference between the two appliances at the end of the observation period. These results also imply that the empirically based mechanism of dental arch development with passive ligation is largely due to the use of broad-shaped arch wires and should not be assigned to the bracket type. However, the outcome of this treatment regimen was not followed after treatment; thus, the stability of the therapy was not investigated. Buccal expansion in the arch is highly unpredictable and can be influenced by various factors including anatomy of the underlying structures, inclination of the molars and architecture of the oral musculature.[3] Damon Q appliance cannot avoid extractions. Straight soft tissue profile and upright incisor position are prerequisite for non-extraction treatment. Moreover, a harmonious chin and lip position is the key leading to the successful non-extraction treatment with Damon Q appliance.[10]

Our study is in agreement with the study conducted by Lorenzo Franchi et al, which concluded that, the low-friction system produced statistically significant increases in the transverse dentoalveolar width and the perimeter of the maxillary arch during the levelling and aligning phases of treatment.[6] Our study is in agreement with the study conducted by Sayed YM et al, which revealed that the correction of crowding in Damon Q system was achieved through expansion of the dental arches and mandibular incisors proclination.[10]

CONCLUSION

Damon System have challenged several aspects of conventional orthodontic thought and treatment pattern. Damon system is a breakthrough in orthodontic treatment mechanics. Damon system is based on Bio-Adaptive Therapy (BAT), which is an emerging treatment modality in fixed orthodontic treatment. Utilizing bio-adaptive response of the dentition and alveolar bone, dramatic results can be achieved for patients in significantly less time, with fewer appointments and with less discomfort compared to traditional fixed orthodontic treatment approach.

The Damon System delivers ideal tooth position and improved facial symmetry than conventional orthodontic treatment.

The Three Pillars of Damon System for Bio-Adaptive Therapy have evolved due to the combination of three major elements:

- Passive Self-Ligating Brackets: Provide low friction.

- High-Tech Alloy Wires: Provide continuous low force.

• A New System of Mechanics: Provide simpler treatment protocols, which create beautiful smiles and beautiful faces.

The following conclusions can be drawn from the study:

1. There are significant differences in average posttreatment maxillary and mandibular anterior and posterior arch widths in patients treated with or without premolar extractions in all the groups.

2. Posttreatment anterior arch width widening is seen in both extraction and non-extraction patients in all the groups.

3. In Damon Q non extraction group, extraction group, and in MBT non extraction group there is expansion of arches in all the cases. Where as in MBT extraction group there is narrowing of arch. The expansion achieved can be put in descending order from Damon Q non extraction, Damon Q extraction, MBT non extraction and MBT extraction.

CONFLICT OF INTEREST

No potential academic conflict of interest relevant to the above article was reported.

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