Comparison of Alastik Chains with Elastics Involved with Intra-Arch Molar to Molar Forces

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Introduction

From clinical observations it was noticed that alastik chains are effective in condensing arches that have generalized spacing but they are less effective in retracting canines when one uses continuous archwires and edgewise brackets. It was also noticed that the alastik chains, when cut into segments, are quite effective in condensing anterior spacing from canine to canine.

Other observations made as one used alastik chains to close spaces are as follows: After a three to four week interval of time, the alastik chain appears to be permanently elongated a considerable amount, and there also appears to be very little force left in the chain after this time period. In addition, the alastik chain appears to be discolored with the change in appearance varying in shades of colors at the time of the next appointment.

Since the forces involved are intra-arch forces and the maximum distances of space closure are from molar to molar, the question that is raised is: what material shall one choose to close the spaces? The choices presented are: 1) wire in the form of closing loops, 2) wire in the form of springs, 3) intra-arch elastics and 4) alastiks. In this investigation the materials were narrowed to elastics and alastiks because the range of material activation is usually greater than those of springs or closing loops. The exception to this is the high range of wire loop activation achieved in the Burstone segmented arch technique.

In order to look at the question of material choice, it was decided to observe the elastic force changes occurring in the two materials (i.e., molar to molar elastics and alastik chains) and describe these force changes within a certain period of time as they would likely occur in the mouth.

Literature Review

The literature was searched for studies of elastics and alastiks related to applied forces.[1,2,3,4,5] However, none of these investigations pertained to applied molar to molar forces; therefore relevant comparisons are missing.

Objectives of the Investigation

A new material was introduced to be used by orthodontists which is basically a plastic elastic known on the market as an alastik. To demonstrate how this material either behaves by itself or when compared with elastics is the purpose of this study. Another specific aim of the study is to give the clinician an understanding of the force ranges which this material will produce when used under all possible stretches for molar to molar forces involving space closure up to a three-week interval of time.

Procedure

Before beginning this investigation, it was decided that one has to know the distances which the alastik chains and elastics are actually stretched in the

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mouth when used as a molar to molar force. Thirty nonextraction cases (maximum arch length) and thirty treated extraction cases (minimum arch length) were measured from the mesial of the first maxillary molar of one side to a corresponding point on the other maxillary molar. The maximum and minimum stretches were 105 mm and 65 mm; therefore these values were used as the two limits of stretches in the study. Alastik chains and elastics were stretched at intervals of 10 mm between these two extremes so that the the results will be applicable to almost all clinical situations involving molar to molar forces.

The total time of the test was based on the assumption that the patient is seen by the orthodontist every three weeks. This three week time period was divided into the following intervals - initial time (0); one hour, eight hours; twenty-four hours, one week; two weeks, and three weeks. This was done in order to learn of the relative changes occurring throughout the whole time period, because some orthodontists may change elastics or alastiks at any time interval between one and twenty-one days.

Methods and Materials

Surgical bonded latex elastics, ⅝″ and ¾″, were purchased from three independent companies in addition to standard and heavy chain alastiks that were purchased from one company. Each (elastic or alastik) was stretched a specified distance (65 mm to 105 mm) with a Correx gauge which recorded the maximum force at the specified stretch.

Five wire frames of 65, 75, 85, 95 and 105 mm were made to hold the material at the specified stretch for each time interval of measurement.

Sample tests of 10 elastics and 10 alastiks were compared under six environmental conditions to answer the questions of how different environments affect the elastics and alastiks.

Each sample was tested under the following conditions for three weeks: 1) dry materials at room temperature; 2) materials submerged in water at room temperature; 3) materials submerged in saliva at room temperature; 4) dry materials heated to a constant three-week temperature of 37°C; 5) materials submerged in a constant saliva temperature of 37° C (normal body temperature and close to mouth temperature).

Three hundred elastics (3 companies x 2 sizes x 5 stretches x 10 sample size) were tested for changes in elasticity occurring in eight time intervals for three weeks. One hundred alastik chains (1 company x 2 types x 5 stretches x 10 sample size) were similarly tested.

Mean forces and their standard deviations were computed for each sample. Mean per cent forces remaining in the material and their standard deviations were also computed for each sample. Within "t" tests were used to find relative differences between samples, between time intervals, and between material types. The variables studied are the interrelations of 1) force magnitude, 2) distances of stretch, 3) time, and 4) material type.

Inter- and intraexaminer variability is reported for two independent observers in order to demonstrate the reliability of repeating the experiment and obtaining nearly the same results. No significant differences were found between examiners. The standard deviation for examiner A was 1.4 gm and for examiner B was 1.15 gm.

Interexaminer variability between A and B is 1.3 standard deviations in terms of a "t" test. Significance was determined at 1.96 standard deviations.

Findings

It was found from pilot studies that to stimulate mouth conditions, alastiks are best tested in water at 37°C and elastics in water at room temperature. There is no statistical significant difference between the conditions mentioned above and the same materials tested under saliva at 37°C. From this point in the investigation all alastiks were measured after submersion in water at 37° for different time intervals and all elastics were measured after submersion in water at room temperature.

Mean forces and standard deviations of the 300 elastics and 100 alastiks as well as "t" tests between different time intervals were calculated on the computer. An abstract of the changes occurring in each material is illustrated in the following tables (Tables 1 and 2) and graphs (Graphs 1, 2, and 3).

The above data are plotted in graphic form for a visual representation of the numerical force ranges. One can thus comprehend the similarities and differences between these two materials.

Discussion

The clinical observation that the plastic material is permanently elongated more than the rubber material is confirmed by measurement. Alastik chains are permanently deformed by approximately 50 per cent of their original length; comparatively, elastics are permanently deformed by 23 per cent of their original lengths measured at the maximum 105 mm stretch. This permanent deformation starts at the original stretch and increases with time; also the less the original stretch, the less percentage deformity occurs.

Three phenomena common to both materials were noticed in the pilot study. 1) Both alastiks and elastics take a stain from saliva. 2) Under all environmental conditions most of the loss or decay in force occurs within twenty-four hours. 3) Wetness (in saliva or water) decreases the measured forces in both alastiks and elastics.

It can also be noticed that there is variability in the forces of elastics and alastiks in the same lot. This variability is greater in alastiks than in elastics; e.g., the standard deviations of standdard alastiks at different periods of time and at different stretches vary from 7.5:24.3 gms; for heavy alastiks the variation is from 1.7:29.9 gms; for ⅝ elastics, variation is from 1.8:13.8 gm/S.D.; and for ¾ elastics, variation is from 1.0:6.5 gm/S.D.

Conclusions

1. There is an initial decay (drop of force) and most of this drop occurs during the first day. The percentage is 74.21±5.8 for alastik chains; 41.6±4.1 for ¾ elastics, and 42.9±3.3 for ⅝ elastics.

2. The greatest per cent force-decay per unit of time occurred during the first hour. The percentage is 55.7±6.7% for alastik chains compared with 26.4±6.4 for ¾ elastics, and 28.3±4.5 for ⅝ elastics.

3. After this extreme rate of force decay in the first day, the remaining rate of decay for the total period of three weeks is 8.2±4.1 per cent for alastik chains compared with 5.5±3.8 per cent for ¾ elastics and 4.7±3.3 per cent for ⅝ elastics. This means for all practical purposes that after the first day there is a reasonably constant force remaining in the two materials throughout the three-week period. It also means the longer the material is left in the mouth, the less the rate of force decay.

4. The over-all behavior of the standard and heavy chains of alastiks is about the same. Two points were noted.

TIME INTEGRATED LOAD DEFLECTION RATES

IN TERMS OF MEANS AND STANDARD DEVIATIONS IN GRAMS

Standard Chain Alastik
(N=10 per stretch)

	0 Hour	1 Hour	4 Hours	8 Hours	24 Hours	1 Week	2 Weeks	3 Weeks
65mm	263 ± 24.3	170 ± 12.1	153 ± 13.6	141 ± 14.2	129 ± 11.1	111 ± 11.6	108 ± 11.4	97 ± 10.5
75mm	300 ± 9.4	200 ± 7.5	188 ± 11.4	175 ± 15.0	163 ± 13.4	134 ± 8.7	122 ± 10.7	122 ± 12.1
85mm	333 ± 20.0	201 ± 21.6	185 ± 21.5	177 ± 20.8	161 ± 20.7	141 ± 19.2	140 ± 19.4	140 ± 17.3
95mm	393 ± 21.9	280 ± 20.4	234 ± 23.7	220 ± 24.4	212 ± 22.2	174 ± 20.1	170 ± 19.8	161 ± 16.8
105mm	420 ± 21.4	263 ± 16.7	237 ± 14.1	230 ± 14.4	215 ± 11.6	173 ± 15.3	168 ± 14.0	154 ± 13.1
				Heavy Chain Alastik				
65mm	287 ± 16.7	180 ± 14.1	157 ± 11.8	141 ± 9.5	131 ± 9.2	107 ± 7.8	110 ± 6.3	105 ± 9.2
75mm	344 ± 9.1	218 ± 11.6	191 ± 14.8	174 ± 12.8	142 ± 12.4	110 ± 12.8	105 ± 11.1	90 ± 9.4
85mm	424 ± 16.8	258 ± 14.6	227 ± 12.6	210 ± 14.1	173 ± 14.3	145 ± 13.6	134 ± 10.9	125 ± 11.4
95mm	495 ± 17.4	270 ± 18.4	251 ± 22.3	218 ± 16.6	180 ± 16.8	151 ± 12.4	143 ± 12.6	139 ± 14.6
05mm	567 ± 23.2	358 ± 29.9	294 ± 23.7	258 ± 23.5	228 ± 24.8	168 ± 21.3	98 ± 1.7	98 ± 1.7

Table 1 Time integrated load deflection rates of alastik chains.

TIME INTEGRATED LOAD DEFLECTION RATES

IN TERMS OF MEANS AND STANDARD DEVIATIONS IN GRAMS

5/8 Light Elastics
(N=10 per stretch)

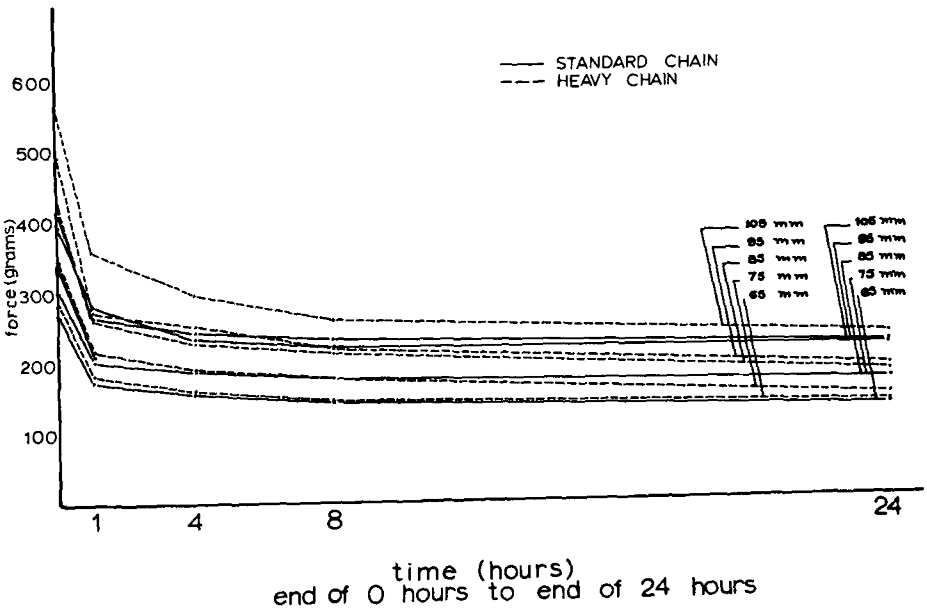
	0 Hour	1 Hour	4 Hours	8 Hours	24 Hours	1 Week	2 Weeks	3 Weeks
65mm	95 ± 3.3	68 ± 3.0	63 ± 3.1	59 ± 3.3	54 ± 2.8	51 ± 1.8	50 ± 1.9	48 ± 2.7
75mm	108 ± 5.4	74 ± 5.2	68 ± 4.1	67 ± 4.6	63 ± 3.7	57 ± 4.2	55 ± 4.2	53 ± 2.6
85mm	144 ± 5.0	82 ± 5.3	81 ± 7.3	75 ± 7.0	70 ± 7.4	64 ± 5.7	61 ± 4.9	59 ± 5.6
95mm	160 ± 11.0	94 ± 3.4	85 ± 4.4	78 ± 4.7	75 ± 4.6	71 ± 2.7	70 ± 4.1	67 ± 2.9
105mm	198 ± 13.8	99 ± 10.3	89 ± 6.3	88 ± 9.1	81 ± 6.5	77 ± 6.6	77 ± 6.3	73 ± 6.9
				3/4 Light Elastics				
65mm	87 ± 6.5	64 ± 1.9	61 ± 1.5	57 ± 2.7	50 ± 1.0	49 ± 3.6	49 ± 3.1	46 ± 1.1
75mm	96 ± 5.8	72 ± 2.6	65 ± 1.9	62 ± 1.9	56 ± 1.4	55 ± 1.8	53 ± 1.1	51 ± 1.1
85mm	115 ± 5.7	87 ± 6.1	77 ± 2.4	75 ± 2.1	65 ± 2.3	63 ± 1.7	61 ± 1.6	59 ± 1.3
95mm	134 ± 3.4	92 ± 4.3	84 ± 2.0	81 ± 1.7	76 ± 1.8	71 + 2.5	69 ± 1.8	67 ± 1.4
105mm	154 ± 4.8	96 ± 3.3	87 ± 1.9	82 ± 2.8	79 ± 2.0	76 ± 2.4	72 ± 3.6	74 ± 2.9

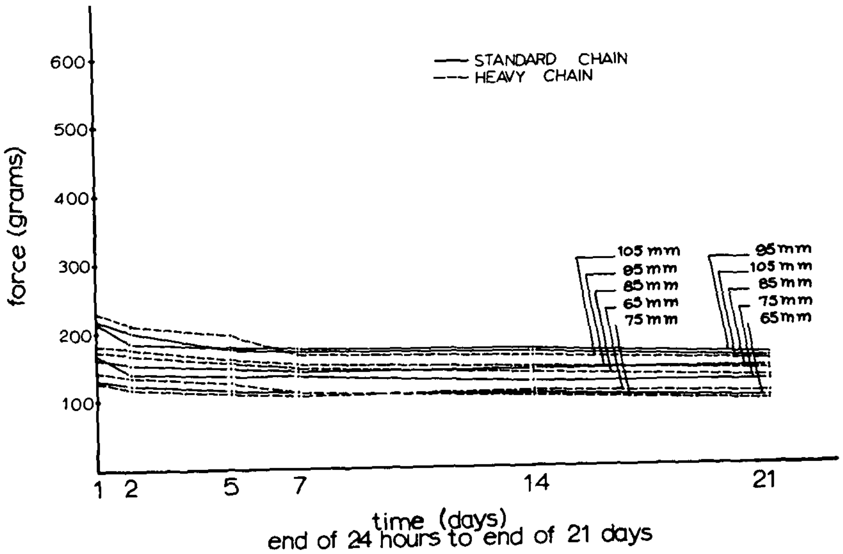
Table 2 Time integrated load deflection rates of elastics.

A) The heavy chains of alastiks have an initial stronger force when compared with the standard chain under similar conditions. B) It was found that the rate of force decay was greater for heavy chains compared with the standard chains after eight hours, and the two curves crossed; therefore the force values for standard alastik chains will be higher than the heavy chains after eight hours for all stretches except one which also behaved in a similar manner after seven days.

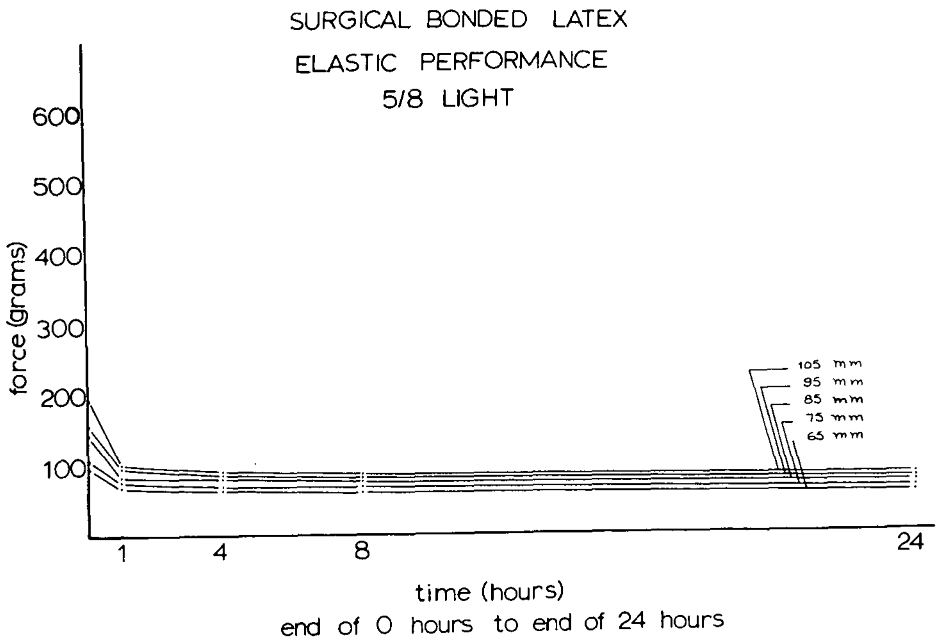
5. One advantage of alastiks is that the clinician knows the force is acting on the teeth all the time despite the decay because he seats the alastik chain over the bracket and the alastik chain also serves as a ligature tie; whereas with elastics, cooperation is needed in order to have the patient place the elastic in the mouth.

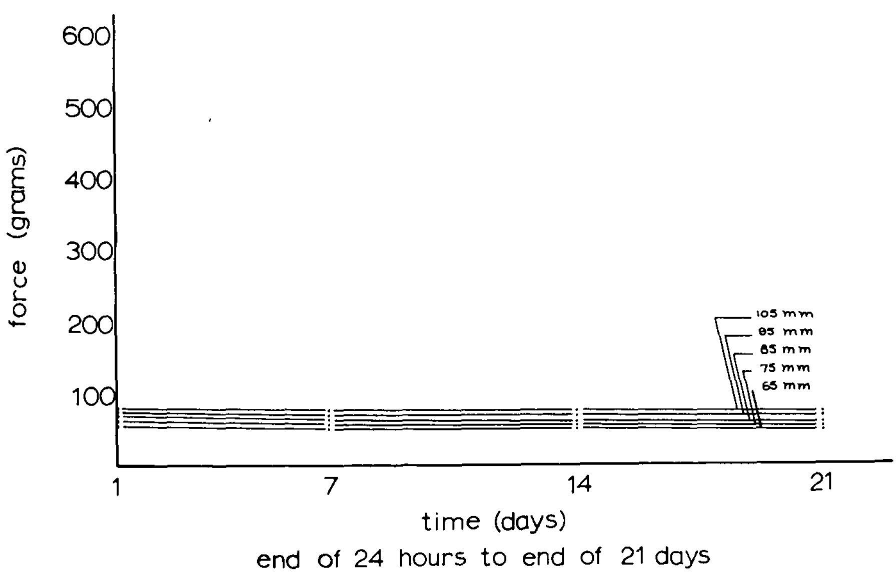
ALASTIK CHAIN PERFORMANCE



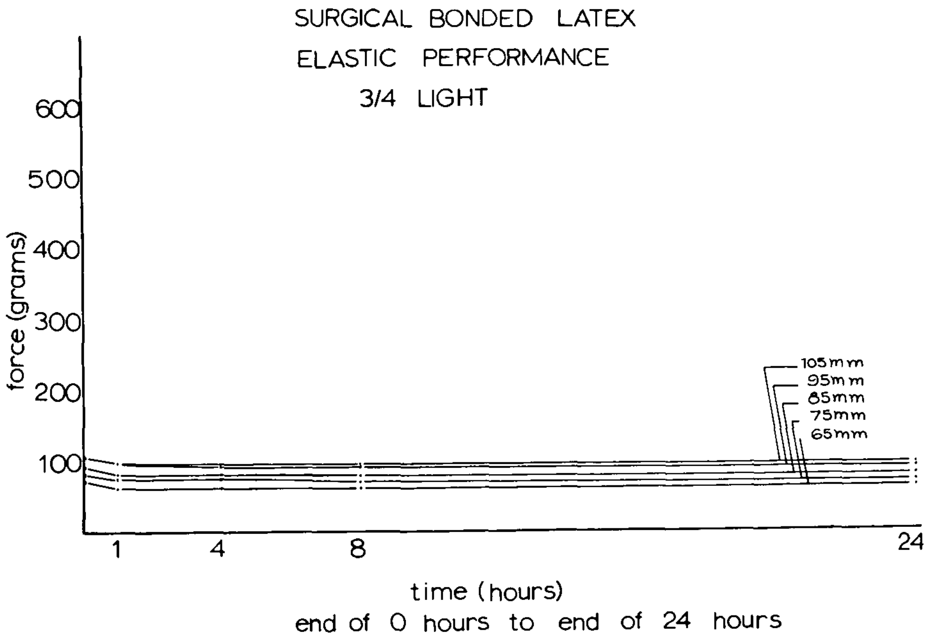


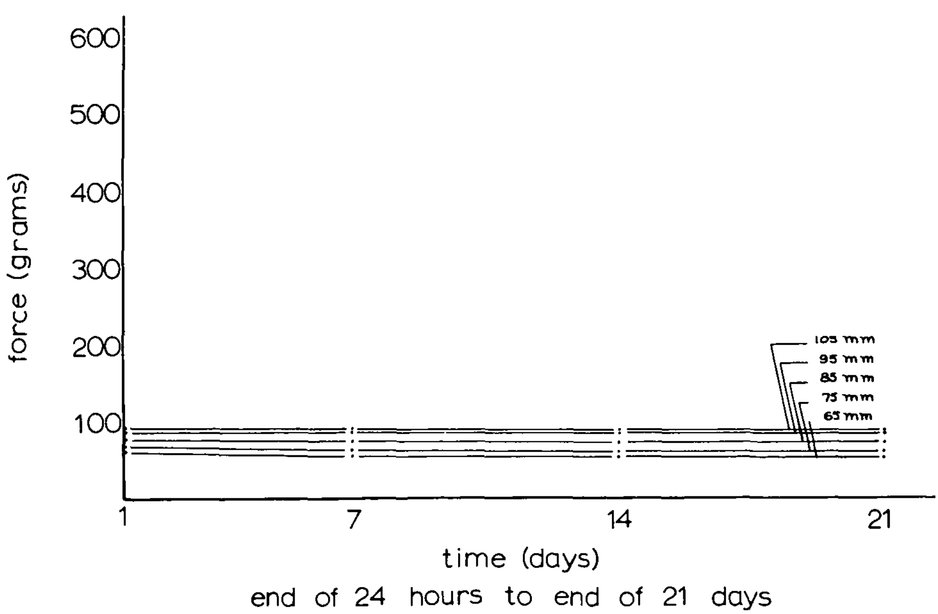
Graph 1 Above — twenty-four hour load deflection curves for alastik chains; below — three-week load deflection curves for alastik chains.





Graph 2 Above — Twenty-four hour load deflection curves for ⅝ light elastics; below — three-week load deflection curves for ⅝ light elastics.





Graph 3 Above — Twenty-four hour load deflection curves for ¾ light elastics; below — three-week load deflection curves for ¾ light elastics.

6. There is a decrease in force of each material used, independent from tooth movement. One should understand that the initial force measured in the mouth will not be the same force acting on the teeth after the first few hours. He should therefore choose alastiks that have initial forces about four times greater than those forces he wishes to have on the tooth after the first day because the first day decay of alastik force is approximately 75 per cent. For example, if one wishes to apply 100 grams of force to an arch, he should choose an alastik with an initial force of 400 grams for the distance he wishes to stretch it. Since elastics lose about 40 per cent of their initial force after one day, the same principle can be applied as to alastiks. If one wishes to apply 100 grams of force to an arch for molar to molar distances, he should choose an elastic with an initial force of 140 grams.

7. Although the alastik chains lose a greater percentage of their force during the first day, the remaining force for the next three weeks is still greater than ⅝ or ¾ molar to molar elastics when stretched to the same distances (65 to 105 mm) under the same conditions; it is advisable to use alastiks when more molar to molar force is needed to overcome friction expected in appliance design.

8. The reliability of applied forces is greater in the elastics because the variability is 11.4 grams less than the variability of alastik chains. Average comparative standard deviations are 5.2 grams for elastics and 16.6 grams for alastik chains. One is, therefore, more certain that the force is being applied to the teeth in a reasonable force range when he uses elastics versus using alastik chains; i.e., the applied forces in elastics are more predictable than in alastik chains.

9. It is recommended that:

a) Alastik chains be used where there is generalized spacing of small distances between teeth. The alastik chain is used with brackets and archwires because one needs a greater remaining force to overcome appliance interference or friction.

b) Molar to molar elastics, ¾ and ⅝, are better used to close spaces when bands are removed because the force magnitude is in the 60 to 90 gram (2 to 3 ounce) range which is found to be clinically effective in closing band spaces by tipping.

c) One should consider the amount of decay in each material when choosing the initial force.

References

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