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Research Article

Effectiveness of Anchorage Reinforcement using Skeletally Anchored Class II Elastics in Adolescent Patients

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Abstract

Background: In growing patients with class II mandibular malocclusion, functional appliances and class II elastics are commonly used for mandibular advancement based on growth modification. However, excessive proclination of lower incisors and other undesirable consequences usually result from the use of monobloc appliance during orthodontic treatment.

Objective: To compare the effects of skeletally anchored Class II elastics on skeletal, dentoalveolar, and soft tissue with a matched control group treated with a monobloc appliance for the treatment of skeletal Class II malocclusion caused to mandibular retrusion.

Materials and Methods: This study was conducted among adolescents in Orthodontics Department, Bangabandhu Sheikh Mujib Medical University (BSMMU). A sample of 16 adolescents aged 13-18 years were selected at random who required class II malocclusion treatment. Sample was divided into two equal groups. A computer sequence generator carried out randomization with a 1:1 allocation ratio. In the elastics group, twelve patients were treated with skeletally anchored Class II elastics. Two miniplates were placed bilaterally at the ramus of the mandible and the other two miniplates were placed at the aperture piriformis area of the maxilla. In the monobloc group, patients used the monobloc appliance. The active elastics treatment time was considerably eight months for both groups. The changes observed in each phase of treatment were assessed statistically by measurements from lateral cephalometric radiographs. Nonparametric tests were employed in this study due to the small sample size. Evaluation of the changes seen at each treatment phase was done using the Wilcoxon matched-pair sign test and significant value was expressed at $P < 0.05$.

Results: In Co-Gn, B-VRL, U1-PP, U1-VRL, and Ls-VRL, there were statistically significant group differences, and the elastics group showed significantly higher values of these parameters ($P < .05$). In our study, the mandibular incisors demonstrated protrusion in the monobloc group (99.51 ± 1.69°, P=0.028) while retrusion was observed in the elastics group (93,85 ± 1.35°, P = 0.028; $P < .05$).

Conclusions: Miniplate anchorage was used to eliminate the unfavorable dentoalveolar consequences of the monobloc appliance. Skeletal anchoring therapies, an alternative for treating skeletal Class II patients with mandibular insufficiency, can produce favorable skeletal results.

Keywords: Activator; Class II; Functional Treatment; Skeletal Anchorage

Introduction

Approximately 30% of the population are affected by class II malocclusion, one of the most prevalent orthodontic diseases [1,2]. A combination of mandibular retrusion and maxillary protrusion may result in skeletal Class II malocclusion [3]. The most prevalent of them is mandibular retrusion [4]. For the management of this malocclusion, a variety of functional appliances, both permanent and removable, are available [5-7].

Their main objective is to promote mandibular development by the mandible positioned forward. Many studies have demonstrated the effectiveness of both fixed and removable functional appliances; however, there have also been reports of unfavourable dental side effects, including retrusion of maxillary incisors, labial tipping of mandibular incisors, distal and intrusive movement of maxillary posterior teeth, and mesial movement of the mandibular dentition. These could reduce the skeletal impacts of appliances that function [7-11].

Several authors have recently shown various methods to address this issue. Miniscrew anchorage in conjunction with the Forsus Fatigue Resistant Device (FRD) was utilised by Aslan., *et al*. [12]. To improve the mandibular dentition's anchorage and prevent the mandibular incisors from tipping, Unal., *et al*. [11]. and Celikoglu., *et al*. [10]. used the Forsus FRD appliance with miniplate anchorage placed in the mandibular symphysis. Nevertheless, no study employed skeletal anchoring to prevent maxillary incisor retrusion and strengthen the anchorage of the maxillary dentition.

This pilot study aimed to assess the effects of skeletally anchored Class II elastics on the skeleton, dentoalveolar structure, and soft tissues. The results were compared with a matched control group that received treatment with a monobloc appliance for the correction of skeletal Class II malocclusion caused by mandibular retrusion.

Materials and Methods

Approval of the ethics committee of Bangabandhu Sheikh Mujib Medical University was obtained before embarking on the treatment. Sixteen adolescent patients were randomized in a 1:1 ratio in 2 groups (8 patients in each group). Patients who showed up for orthodontic treatment with fixed appliances were recruited at the outpatient clinic of the Orthodontic Department in the University. The inclusion criteria weremild to moderate class II malocclusion (¼ to ½ unit canine relationship), no caries, missing teeth, periodontal disease, and adequate oral hygiene. Subjects were excluded if they were unwilling to be assigned to any of the approaches or had any abnormal oral or medical condition contraindicating orthodontic treatment. Consent was obtained from the patients' parents, as they were adolescents, before their recruitment.

This study was conducted according to the previous study., *et al*. [13]. The sample was divided randomly into two equal groups. The conventional group underwent regular treatment using monobloc appliances (Figure 1). The patients were instructed to use the appliance 24 hours per day except during meals.

While the surgical intervention was assigned to the elastics group and treated with skeletally anchored Class II elastics. In those patients, two miniplates (Stryker, Leibinger, GmbH and Co KG, Freiburg, Germany) were placed bilaterally at the ramus of the mandible and another two miniplates were placed at the aperture piriformis area of the maxilla under local anesthesia by a surgeon. The minipls were adjusted and fixed by three miniscrews (diameter, 2 mm; length, 7 mm; Figure 2). Class II elastics of 500 gf were used bilaterally between miniplates. The patients were educated on how to use the class II elastics and were instructed to start using it daily (24 h per day). A timetable was given for each patient during the use of class II elastics in order to record the number of hours of wear per day.

Patients were asked to attend follow-up visits every 6 weeks to check the progress and evaluation of the stability of mini-implants. Patients of both groupsused their elastics and appliances until a Class I canine and molar relationship was achieved and the increased overjet was eliminated. Results were assessed by measurements from the lateral cephalometric radiograph (Figure 3). Using the same cephalostat, standardized lateral cephalograms were recorded within the two weeks of the treatment start (T1) and at the end of treatment (T2; right after the increased overjet was corrected). Data evaluation for the outcome was done by importing lateral cephalometric radiographsinto medical imaging software (Oris Ceph, Elite Computer, Vimodrone, Milano, Italy). The definitions of cephalometric landmarks had been mentioned in table 1.

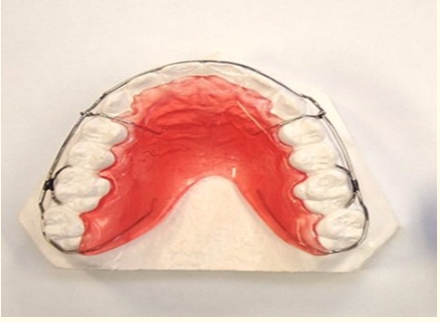

Figure 1: Design of Monoblock.

Figure 2: Intraoral view of placing mini-implant.

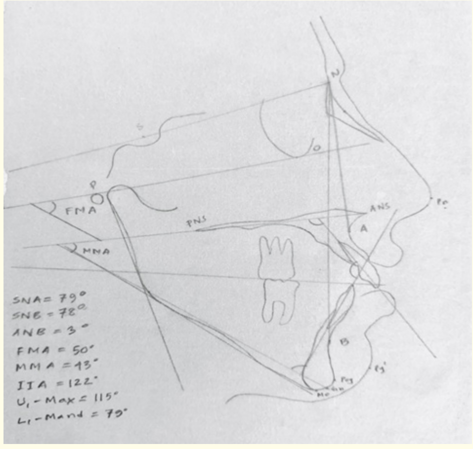

Figure 3: Lateral cephalogram analysis.

Statistical analysis

After obtaining data, statistical analysis was performed with the SPSS software (SPSS for Windows, Version 22.0, Chicago, 22, USA).Nonparametric tests were employed in this study due to the small sample size. The Wilcoxon matched-pair sign test was utilized to assess the alterations noted during every stage of the treatment. The significant value was set at $p < 0.05$.

Results

Miniplate usage did not result in any additional negative effects, such as fracture or infection. Nonparametric tests were employed in this study due to the small sample size. Evaluation of the changes seen at each treatment phase was done using the Wilcoxon matched-pair sign test. Table2 displays the Wilcoxon signed rank

	Abbreviation	Definition
1	SNA (°)	Angle between the lines sella-nasion and nasion–A-point
2	Co-A (mm)	Effective maxillary length between condylion and A-point
3	A-VRL (mm)	Distance between A-point and vertical reference line
4	A-HRL (mm)	Distance between A- point and horizontal reference line
5	SNB (°)	Angle between the lines sella-nasion and nasion–B-point
6	Co-Gn (mm)	Effective mandibular length between condylion and gnathion
7	B-VRL (mm)	Distance between B-point and vertical reference line
8	B-HRL (mm)	Distance between B-point and horizontal reference line
9	Pog-VRL (mm)	Distance between pogonion and vertical reference line
10	Pog-HRL (mm)	Distance between pogonion and horizontal reference line
11	ANB (°)	Angle between the lines A-point–nasion and nasion–B-point
12	Convexity (°)	Angle between nasion–A-point and A-point–pogonion
13	Wits (mm)	Drawn perpendiculars from points A and B onto the occlusal plane and measured distance between these two points
14	SN-PP (°)	Angle between sella-nasion and palatal plane
15	SN-OP (°)	Angle between sella-nasion and occlusal plane
16	SN-GoGn (°)	Angle between sella-nasion and mandibular plane
17	FMA (°)	Angle between Frankfurt horizontal and mandibular planes
18	U1-PP (°)	Angle between palatal plane and long axis of maxillary incisor
19	IMPA (°)	Angle between mandibular plane and long axis of mandibular incisor
20	U1/L1 (°)	Angle between maxillary incisor axis and mandibular incisor axis
21	U1-VRL (mm)	Distance from maxillary incisor tip to vertical reference line
22	L1-VRL (mm)	Distance from mandibular incisor tip to vertical reference line
23	Overjet (mm)	Distance from the mandibular incisor to maxillary incisor tips on the sagittal plane
24	Overbite (mm)	Distance from mandibular incisor to maxillary incisor tips on the vertical plane
25	Ls-VRL (mm)	Distance from upper lip to vertical reference line
26	Li-VRL (mm)	Distance from lower lip to vertical reference line
27	Pog(s)-VRL (mm)	Distance from soft tissue pogonion to vertical reference line

Table 1: Definitions of Cephalometric Landmarks.

test results. Maxillary measures of SNA and Co-A in the elastics group did not alter significantly (P > .05). Mandibular alterations were the primary cause of the malocclusion correction (P < .05). The reduction in maxillomandibular measures, the posterior rotation of the mandibular and occlusal planes, and the forward movement of the upper lip and soft tissue pogonion were all significant findings (all P < .05). Mandibular incisor retrusion, maxillary incisor protrusion, and a reduction in overjet and overbite were also noted (all P < .05). In the monobloc group, A-HRL (.031; P < .05) was the only maxillary parameter to demonstrate any discernible alterations. But there were also noticeable increases in mandibular measures, maxillary incisor retrusion, mandibular incisor protrusion, and a decrease in overjet and overbite (all P < .05). The decrease in maxillomandibular measurements, the increase in vertical measurements (except for SN-PP), and the forward displacement of the soft tissue pogonion and lower lip were all statistically significant (all P < .05).In our study, the mandibular incisors demonstrated protrusion in the monobloc group (99.51 ± 1.69°, P = 0.028) while retrusion was observed in the elastics group (93,85 ± 1.35°, P = 0.028; P < .05).

Total, N=16	Elastics Group (n = 8)			Monobloc Group (n = 8)		
	(T1), Mean/SD	(T2), Mean/SD	P value	(T1), Mean/SD	(T2), Mean/ SD	P value
Maxillary measurements						
SNA (8)	80.01 ± 0.66	79.92 ± 1.02	0.753	80.82 ± 0.89	80.16 ± 1.10	0. 301
Co-A (mm)	79.53 ±2.11	80.60 ± 1.56	.169	81.90 ± 4.39	82.46 ± 4.30	.292
A-VRL (mm)	58.01 ± 6.02	59.42 ± 5.72	.041	57.16 ± 9.7	55.21 ± 9.29	.760
A-HRL (mm)	50.41 ± 7.13	52.32 ± 6.92	.019	49.97 ± 3.91	51.45 ± 4.34	.031
Mandibular measurements						
SNB (8)	72.23 ± 0.77	73.53 ± 1.21	.022	74.78 ± 1.21	77.33 ± 1.34	.027
Co-Gn (mm)	95.89 ± 2.57	102.98 ± 2.11	.023	101.83 ± 4.83	104.99 ± 5.34	.035
B- VRL (mm)	46.39 ± 10.20	52.19 ± 8.83	.024	47.53 ± 9.21	49.46 ±9.45	.024
B- HRL (mm)	81.19 ±7.69	83.38 ± 7.41	.029	82.28 ± 4.59	85.03 ±4.10	.050
Pog-VRL (mm)	50.71 ± 9.78	52.73 ± 9.87	.043	48.98 ± 11.58	50.81 ± 12.63	.026
Pog-HRL (mm)	92.95 ± 5.83	96.42 ± 5.79	.025	96.01 ± 5.65	97.86 ± 5.88	.050
Maxillomandibular measurements						
ANB (8)	6.22 ±0.61	2.89 ±1.12	.023	5.86 ± 0.77	2.78 ± 0.88	.031
Convexity (8)	11.02 ± 2.65	5.04 ± 3.32	.029	9.54 ± 3.10	3.03 ± 2.47	.043
Wits (mm)	5.54 ± 0.60	2.14 ± 1.17	.025	5.43 ± 0.68	2.56 ± 0.51	.032
Vertical measurements						
SN-PP (8)	3.65 ± 0.55	3.42 ± 1.01	.675	3.43 ± 0.3	2.72 ± 0.82	.232
SN-OP (8)	16.45 ± 3.13	17.22 ± 3.44	.043	18.10 ± 2.46	19.36 ± 2.5	.030
SN-GoGn (8)	31.62 ± 2.03	32.39 ± 1.21	.243	32.53 ± 2.78	33.08 ± 2.64	.044
FMA (8)	24.38 ± 0.79	25.37 ± 0.73	.019	25.31 ± 1.44	26.40 ± 1.10	.030
Dentoalveolar measurements						
U1-PP (8)	111.20 ± 3.21	115.85 ± 4.62	.021	114.13 ± 2.19	111.78 ± 2.61	.050
IMPA (8)	96.86 ± 2.66	93,85 ±1.35	.028	94.06 ± 2.13	99.51 ± 1.69	.028
U1/L1 (8)	123.95 ± 2.07	125.03 ± 2.11	.173	121.26 ±1.23	123.55 ± 2.7	.116
U1- VRL (mm)	61.85 ±9.17	64.98 ± 7.78	.028	60.73 ± 12.27	58.13 ± 11.88	.028
L1- VRL (mm)	63.55 ± 8.18	62.83 ± 8.32	.027	65.91±4.75	69.35 ±4.23	.028
Overjet (mm)	7.98 ± 1.55	3.18 ± 0.50	.028	6.76 ± 1.31	2.95 ±1.10	.028
Overbite (mm)	5.11 ± 1.00	2.58 ± 1.05	.028	5.43 ± 1.81	1.88 ± 1.62	.028
Soft tissue measurements						
Ls-VRL (mm)	70.36 ± 6.60	71.58 ± 6.43	.027	70.28 ± 11.61	69.66 ± 11.54	.463
Li-VRL (mm)	64.58 ± 8.02	64.03 ± 7.85	.249	65.68 ± 10.61	67.38 ±11.65	.027
Pog (s)-VRL (mm)	60.88±8.66	64.38 ±8.06	.028	57.48 ±12.53	59.16 ±12.28	.027

Table 2: Changes in each phase of the groups.

Discussion

Functional appliances are a typical treatment method for young individuals with correcti skeletal Class II malocclusion caused by mandibular retrusion [14]. Similar to other functional appliances, the monobloc has the potential to cause major, undesired dentoalveolar alterations, primarily mandibular incisor flare [15]. Clinicians have used temporary anchoring devices to improve the skeletal contribution and get around this significant adverse effect [10-12,16,17]. This present study compared monobloc treatment, which is often used to treat skeletal Class II malocclusion, with a novel intraoral skeletal anchoring treatment for stimulation of mandibular growth.

Timing appliance therapy to occur at the peak of the pubertal growth spurt has been shown to be crucial, contributing more skeletal effect for molar and overjet correction in the treatment of Class II division 1 malocclusions [18]. Franchi., *et al*. [19] reported significantly greater increases during the pubertal peak in total mandibular length and mandibular ramus height compared with treatment before puberty. Also, prior to treatment, the patients in our study were at MP3cap (capping of the epiphysis on the diaphysis of the middle finger medial phalanx) maturation stage.

The outcomes demonstrated that no statistically significant change in the SNA angle was found in either of the two treatment groups ($P > .05$). This finding is in accordance with the results of others [12,14,20-22]. On the other hand, several studies have reported that treatment with various functional appliances in growing patients demonstrated a high-pull headgear effect on the maxilla [14]. This contradiction may be related to variation of sample groups, treatment start ages of patients, and different treatment mechanics. The increase in another maxillary parameter, Co-A, was not found to be statistically significant in the groups ($P > .05$). According to Bilgiç., *et al*. [23]. this may be related to the lack of change in condylar growth in the sagittal direction. However this study found a significant increase in Co-A which was likely caused by adaptive growth of the condyle [8].

The results of our investigation indicate that there was an increase in the mandible's forward and downward displacement, as indicated by the SNB angle and the Co-Gn, B-VRL, B-HRL, Pog-VRL, and Pog-HRL distances ($P < .05$). These results are in line with those of earlier research on functional appliances [10,15,23].

Most of the earlier research employing other functional appliances found no change in the SN-GoGn angle [8,9,22]. the other hand, this angle increased marginally in the monobloc group and insignificantly in the elastics group in our investigation. This might have resulted from the monobloc group's mandibular posterior teeth extruding.

Several publications have documented dentoalveolar side effects of tooth-borne functional aids like the monobloc [7,21,22]. The monobloc group in the current study had a substantial mandibular incisor protrusion ($P < .05$). Nonetheless, there was a notable retrusion of these teeth in the elastics group ($P < .05$). Mandibular incisor protrusion and maxillary incisor retrusion have been reported to be eliminated following Class II treatment with functional appliances that use skeletal anchorage [10,11]. There was a significant difference ($P < .01$) in the maxillary incisor position following treatment between the two groups. The monobloc group showed maxillary incisor retrusion, which is consistent with the literature [8,15,23]. However, the elastics group showed evidence of these teeth protruding. This situation can be explained by the contact of the labial surfaces of the mandibular incisors with the palatal surfaces of the maxillary incisors as the mandible moves forward under the influence of the intermaxillary elastic forces.

In both treatment groups, soft tissue pogonion moved forward significantly ($P < .05$), improving the facial soft tissue convexity. A slight retrusion of the maxillary lip was observed in the monobloc group. Turkkahraman., *et al.* [17] indicated that this result was attributed to heavy distal forces acting on the maxillary arch and resultant retrusion of the maxillary incisors. In addition, these findings are similar to the soft tissue findings of previous studies [8,11,23]. However, protrusion of the lower lip was found in the monobloc group, whereas a slight retrusion was found in the elastics group ($P < .05$). This difference might be related to the posttreatment inclination of the mandibular incisors. Conversely, some previous studies discovered forward movement of the lower lip with skeletal-anchored functional appliances [10,11]. This contradictory finding may be related to the variance in soft tissue reference lines, treatment start time, soft tissue thickness, and different treatment mechanics.

This research was limited by the small size of the study and control groups. However, we assessed a method of treatment for mandibular retrusion correction that had not been documented before. To further examine and validate our findings, more extensive prospective clinical studies with bigger sample numbers are required.

Conclusion

Compared to the patients receiving monobloc treatment, the miniplate-anchored Class II elastics group's effective mandibular length was substantially longer. In the miniplate-anchored Class II elastics group, mandibular incisor retrusion was noted, while in the monobloc group, mandibular incisor protrusion was reported. There was a decrease in overjet and overbite in both treatment groups. Miniplate anchorage was used to remove the monobloc appliance's unwanted dentoalveolar effects. Skeletal anchoring therapy is a potential alternative for treating skeletal Class II patients with mandibular insufficiency, as it can result in favorable skeletal outcomes.

Bibliography

1. Proffit WR., *et al*. "Prevalence of malocclusion and orthodontic treatment need in the United States: estimates from the NHANES III survey". *The International Journal of Adult Orthodontics and Orthognathic Surgery* 13 (1998): 97-106.

2. Celikoglu M., *et al*. "The pattern of malocclusion in a sample of orthodontic patients from Turkey". *Medicina Oral, Patologia Oral, Cirugia Bucal* 15 (2010): e791-e796.

3. Arici S., *et al*. "Effects of fixed functional appliance treatment on the temporomandibular joint". *American Journal of Orthodontics and Dentofacial Orthopedics* 133 (2008): 809-814.

4. McNamara JA. "Components of Class II malocclusion in children 8-10 years of age". *The Angle Orthodontist* 51 (1981): 177-202.

5. Eastwood AW. "The monobloc appliance". *Dental Clinics of North America* 22 (1978): 739-755.

6. Tumer N and Gultan AS. "Comparison of the effects of monobloc and twin-block appliances on the skeletal and dentoalveolar structures". *American Journal of Orthodontics and Dentofacial Orthopedics* 116 (1999): 460-468.

7. Jones G., *et al*. "Class II non-extraction patients treated with the Forsus Fatigue Resistant Device versus intermaxillary elastics". *The Angle Orthodontist* 78 (2008): 332-338.

8. Karacay S., *et al*. "Forsus Nitinol Flat Spring and Jasper Jumper corrections of Class II division 1 malocclusions". *The Angle Orthodontist* 76 (2006): 666-672.

9. Oztoprak MO., *et al*. "A cephalometric comparative study of Class II correction with Sabbagh Universal Spring (SUS (2)) and Forsus FRD appliances". *European Journal of Dentistry* 6 (2012): 302-310.

10. Celikoglu M., *et al*. "Treatment effects of skeletally anchored Forsus FRD EZ and Herbst appliances: a retrospective clinical study". *The Angle Orthodontist* 86 (2016): 306-314.

11. Unal T., *et al*. "Evaluation of the effects of skeletal anchoraged Forsus FRD using miniplates inserted on mandibular symphysis: a new approach for the treatment of Class II malocclusion". *The Angle Orthodontist* 85 (2015): 413-419.

12. Aslan BI., *et al*. "Treatment effects of the Forsus Fatigue Resistant Device used with miniscrew anchorage". *The Angle Orthodontist* 84 (2014): 76-87.

13. Ozbilek S., *et al*. "Effects of skeletally anchored Class II elastics: A pilot study and new approach for treating Class II malocclusion". *The Angle Orthodontist* 87.4 (2017): 505-512.

14. Koretsi V., *et al*. "Treatment effects of removable functional appliances in patients with Class II malocclusion: a systematic review and meta-analysis". *European Journal of Orthodontics* 37 (2015): 418-434.

15. Casutt C., *et al*. "Success rate and efficiency of activator treatment". *European Journal of Orthodontics* 29 (2007): 614-621.

16. Luzi C and Luzi V. "Skeletal Class II treatment with the miniscrew-anchored Herbst". *Orthodontie Française* 84 (2013): 307-318.

17. Turkkahraman H., *et al*. "Effects of miniplate anchored and conventional Forsus Fatigue Resistant Devices in treatment of Class II malocclusion". *The Angle Orthodontist* 86 (2016): 1026-1032.

18. Jena AK., *et al*. "Skeletal and dentoalveolar effects of twin-block and bionator appliances in the treatment of Class II malocclusion: a comparative study". *American Journal of Orthodontics and Dentofacial Orthopedics* 130 (2009): 594-602.

19. Franchi L., *et al*. "Long-term skeletal and dental effects and treatment timing for functional appliances in Class II malocclusion". *The Angle Orthodontist* 83 (2013): 334-340.

20. Cozza P., *et al*. "Dentoskeletal effects and facial profile changes during activator therapy". *European Journal of Orthodontics* 26 (2004): 293-302.

21. Gunay EA., *et al*. "Evaluation of the immediate dentofacial changes in late adolescent patients treated with the Forsus (TM) FRD". *European Journal of Dentistry* 5 (2011): 423-432.

22. Aras A., *et al*. "Comparison of treatments with the Forsus fatigue resistant device in relation to skeletal maturity: a cephalometric and magnetic resonance imaging study". *American Journal of Orthodontics and Dentofacial Orthopedics* 140 (2011): 616-625.

23. Bilgic F., *et al*. "Comparison of Forsus FRD EZ and Andresen activator in the treatment of Class II, Division 1 malocclusions". *Clinical Oral Investigations* 19 (2015): 445-451.