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Prevalence and type of pain during conventional and self-ligating orthodontic treatment

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SUMMARY This study investigated the prevalence and type of pain experienced during orthodontic treatment in 30 subjects (12 males, 18 females, aged 12–18 years) with crowding. Fifteen patients were treated with conventional brackets (Victory Series) and 15 with self-ligating brackets (Damon SL II). The first archwire for all patients was a 0.014 inch nickel–titanium (NiTi) archwire with a force of approximately 100 g. Conventional brackets were ligated with elastomeric modules. A visual analogue scale (VAS) was used daily to assess the intensity of pain; the use of pain medication was also reported in a specially designed daybook for a total period of 3 months. Pearson's chi-square was used to investigate the difference between groups in the frequency of pain experience, its nature, and the use of analgesia. Non-parametric statistics (Mann–Whitney *U*-test) were computed to compare pain intensity between the groups. To investigate reported pain assessments, Friedman's two-way analysis of variance was used and the differences were estimated using Wilcoxon's signed-rank test.

The results showed that pain was reported for a period of 9 days after archwire insertion. Patients treated with self-ligating brackets reported the highest pain intensity on the day following placement of the first archwire (VAS mean = 42.6), while those treated with conventional brackets experienced the greatest pain intensity at placement of the first archwire (VAS mean = 52) and after the second orthodontic appointment (VAS mean = 59.6). Analgesics were used by 16.5 per cent of patients treated with self-ligating brackets and by 10 per cent of those treated with conventional brackets, most often during the first 2 days after archwire placement. Patients treated with conventional brackets reported significantly more 'constant' pain than those treated with self-ligating brackets who complained of 'chewing/biting' pain.

Pain appears to be common during orthodontic treatment but perhaps less intense when self-ligating brackets are used, although no difference was observed in the use of analgesics between those treated with self-ligating or conventional brackets. There were no reports of pain after 7–9 days in either group.

Introduction

The existence of pain during dental treatment is often ignored (Dangott *et al.*, 1978), although 77 per cent of patients report pain during dental visits (Klepac *et al.*, 1980; Vassend, 1993). There are, however, more studies concerning pain experience during orthodontic treatment (Oliver and Knapman, 1985; Kvam *et al.*, 1987; Ngan *et al.*, 1989; Jones and Chan, 1992a,b; Lew, 1993; Scheurer *et al.*, 1996; Fernandes *et al.*, 1998; Bergius *et al.*, 2002). The percentage of adolescents reporting pain during fixed orthodontic treatment has been reported to be 91 per cent, and in 39 per cent of these individuals, pain was experienced during each step of treatment (Lew, 1993).

Bergius *et al.* (2002) observed that separators caused pain in 87 per cent of Swedish teenagers 7 days after insertion and that 27 per cent used medication during the first 2 days after insertion. Other prospective investigations in children and adults revealed that 95 per cent of subjects reported pain (Kvam *et al.*, 1987; Scheurer *et al.*, 1996).

In several studies, it was found that pain was reported mostly during the first 2 days after an intervention (Kvam *et al.*, 1987; Ngan *et al.*, 1989; Scheurer *et al.*, 1996; Fernandes *et al.*, 1998), although it returned to normal levels after 7 days (Ngan *et al.*, 1989; Jones and Chan, 1992a,b; Scheurer *et al.*, 1996; Fernandes *et al.*, 1998). Oliver and Knapman (1985) stated that fear of pain may be a factor which contributes to the refusal to undergo orthodontic treatment.

Pain during orthodontic treatment is associated with compression of the periodontal ligament. The early phase of orthodontic tooth movement involves an acute inflammatory response and pain, characterized by periodontal vasodilatation. Osteoblastic and osteoclastic activities result in an inflammatory response in the surrounding tissues (Otero *et al.*, 1973; Proffit *et al.*, 1986). Depending on the alterations in the periodontium, pain and discomfort are common experiences among orthodontic patients.

A small number of studies have investigated pain based on the type of forces used. Erdinç and Dinçer (2004) investigated the initial time at which pain occurs after insertion of two aligning wires of different sizes (0.014 or 0.016 inch) in the same conventional straightwire appliance in a group of 109 adolescent patients. They also studied the duration of pain, the areas affected within the mouth, the level of self-medication, the effect of this pain on daily life, and whether gender is important in the perception of pain but found no significant differences between the groups in terms of the effect of pain on daily living.

The hypothesis tested in the present study was that the type of archwire used during treatment and the level of force exerted could influence the reactions of the periodontium and result in different levels of pain. Self-ligating brackets have been advocated as being more comfortable and less painful for patients (Shivapuja and Berger, 1994; Damon, 1998a,b; 1999) as well as in reducing chair time (Maijer and Smith, 1990) and were therefore included in the study, together with conventional straightwire brackets.

Subjects and methods

The scientific protocol was approved by the Human Ethics Committee at the University 'G.D'Annunzio' of Chieti, Pescara, and all the subjects signed an informed consent to participate in the study.

Subjects

The sample comprised 30 individuals (18 females and 12 males; average age 16.8 years, range 12–18 years), who were about to commence orthodontic treatment at the Department of Oral Science, University of Chieti, Italy. The inclusion criteria were crowding in both arches and the presence of all permanent teeth, excluding the third molars.

The patients were allocated to one of two groups, ensuring equal numbers of males and females in each group and with the aim of making the groups homogeneous for age and degree of crowding (Table 1). The first group was treated using Damon SL II self-ligating brackets (SDS Ormco, Glendora, California, USA; slot 0.022 inch) and the second with conventional 0.022 inch stainless steel brackets (Victory Series, 3M Unitek, Monrovia, California, USA) (Figure 1).

One author (Simona Tecco) treated all patients. Treatment started with bonding of all brackets in the upper arch and, after 2 days, the first archwire was placed. The first archwire for all patients was a 0.014 inch nickel–titanium (NiTi) archwire with a force level approximately 100 g (SDS Ormco), which was fully engaged in all bracket slots. Conventional brackets were ligated with elastomeric modules (Ligature Ringlet, RMO, Denver, Colorado, USA).

A specially designed daybook that covered a total period of 3 months was given to each subject. The patients were asked to complete the book each evening from placement of the first archwire for 3 months and to record the presence of pain (yes/no), its intensity as recorded on a visual analogue scale (VAS) ('no pain' to 'the highest pain possible'), the characteristics of the pain, and the use of analgesics (including the type and dose).

The characteristics of the pain were indicated using yes/no responses for four descriptors according to the McGill Pain Questionnaire (Melzack, 1975): 'constant', 'shooting', 'dull', and 'pain when chewing or biting', as previously used by Bergius *et al.* (2002).

Each patient attended four appointments during the investigation. At each of the follow-up visits, the clinician checked the daybook and recorded details of the appliance adjustments. The archwires were not changed in any patient at the second and third appointments. Treatment was limited to changing the ligatures, re-bonding any debonded brackets, and re-positioning of the archwire to the midline of the dental arch if there was any slippage.

Table 1 Study population.

	Damon SL II (n = 15)	Victory Series (n = 15)	Difference
Age (years)	16.4 ± 4.5	16.9 ± 3.8	NS
Males	5	7	
Females	10	8	
Crowding (mm)	4 ± 2.5	5 ± 2.0	NS

NS, no significant differences between the groups, according to the Mann–Whitney *U*-test.

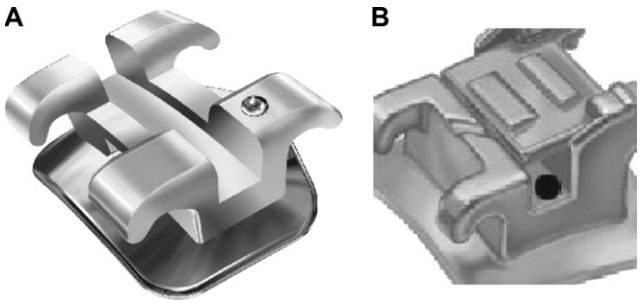

Figure 1 The brackets used in this investigation—(A) conventional; (B) self-ligating.

Statistical analysis

For each variable, simple descriptive statistics were initially calculated. Pearson's chi-square was used to investigate the relationship between groups in terms of the frequency of pain experienced (yes/no), its nature, and the use of analgesia.

For pain intensity, non-parametric statistics (Mann–Whitney *U*-test) were computed to determine any significance between the groups. In order to investigate repeated pain assessments, Friedman's two-way analysis of variance was calculated and the individual differences estimated using Wilcoxon's signed-rank test. Non-significant values were defined as $P > 0.05$.

No statistical analysis was undertaken to assess how gender affected pain due to the small number of subjects in each group.

Results

Intensity of pain

Pain decreased in intensity over time (Figure 2A,B,C). During month 1, VAS scores peaked on day 1 for the Damon SL II group, when the average pain intensity reached 42 (range

13–69, SD: 20.25), while in the Victory Series group, the average pain was 52 on day 1 (range 0–80, SD: 45.07) and remained at approximately the same level on days 2 and 3 (51.6 and 50.3, range 10–75 and 10–71, SD: 36.17 and 34.93, respectively), with a statistically significant difference between the two groups for all three days ($P < 0.05$; Figure 2A).

In the patients treated with Damon SL II brackets, there was a significant ($P < 0.05$) reduction in mean intensity pain score on day 3 (mean 18.83, range 0–43, SD: 16.50), followed by further gradual decreases on days 4–9. No patient then reported pain until the second appointment when the appliance was re-activated (Figure 2A). However, even on day 1 after the second and third appointments, the intensity of pain was never as high as after the insertion of the first archwire (Figures 2B,C).

The finding of the Friedman's two-way analysis of variance and the individual Wilcoxon's tests (Figure 2) indicate that the changes in pain assessments were clearly perceivable over time.

In the patients treated with the Victory Series brackets, the intensity of pain decreased after day 4 but increased again after day 5. It then continued to decrease until the second appointment, although it remained higher than in the Damon SL II group (Figure 2A). VAS scores peaked again two days after the second orthodontic appointment, when the average pain intensity reached 59.66 and 50.33 (range 25–90 and 0–85, SD: 32.72 and 44.61, respectively; Figure 2B.) VAS scores then decreased and remained low during month 3 (Figure 2B,C).

Frequency of patients reporting pain

The majority of patients reported pain during the first 7–9 days after placement of the first archwire, after which no subject reported pain.

One day after insertion of the first archwire, 90 per cent of patients in the Damon SL II group and 95 per cent of subjects in the Victory Series group reported pain (Figure 3A). The percentage of patients reporting pain then gradually reduced and after day 8, only 20 per cent of patients in the Damon SL II group and 30 per cent in the Victory Series group reported pain (Figure 3A). After day 9, no subject reported pain until after the second archwire activation (Figure 3A).

The frequency distribution of pain sensation showed a similar pattern during months 2 and 3 (Figure 3B,C), with no subject reporting pain 8–9 days after the appointment. There was no statistically significant difference between the two groups in terms of the number of individuals experiencing pain during the follow-up (Figure 3).

Pain characteristics

The types of pain most commonly described by the subjects in this study were constant pain and pain when chewing/biting. The other two pain descriptors (shooting and dull) were used to a lesser extent.

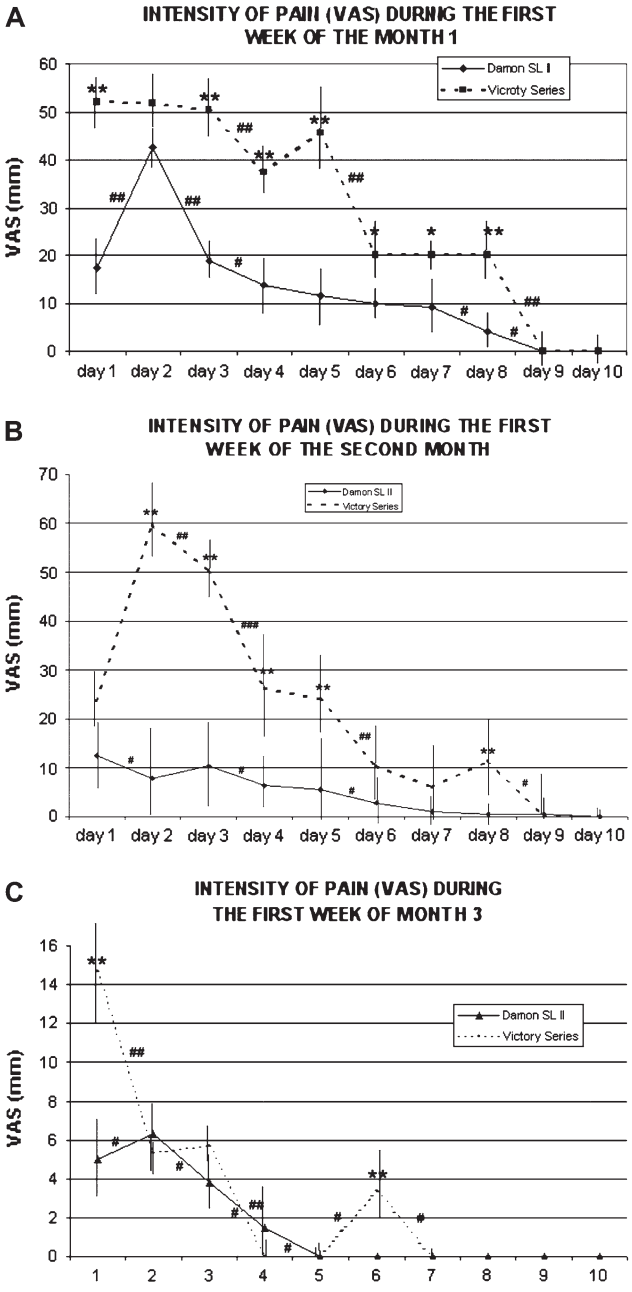

Figure 2 Mean intensity of pain during (A) week 1 month 1, (B) week 1 month 2, and (C) week 1 month 3. Significant differences between groups are indicated by $*P < 0.05$ and $**P < 0.01$. Significant intra-group differences are indicated by $\#P < 0.05$ and $\#\#P < 0.01$.

In the patients treated with Damon SL II, fewer than 25 per cent experienced constant pain during any of the follow-up periods; the majority reported pain when chewing/biting. These patients reported a significantly higher percentage of chewing/biting pain than those patients treated with conventional brackets for the first five days of month 1 (Figure 3A), the first two days of month 2 (Figure 3B), and the first three days of month 3 (Figure 3C).

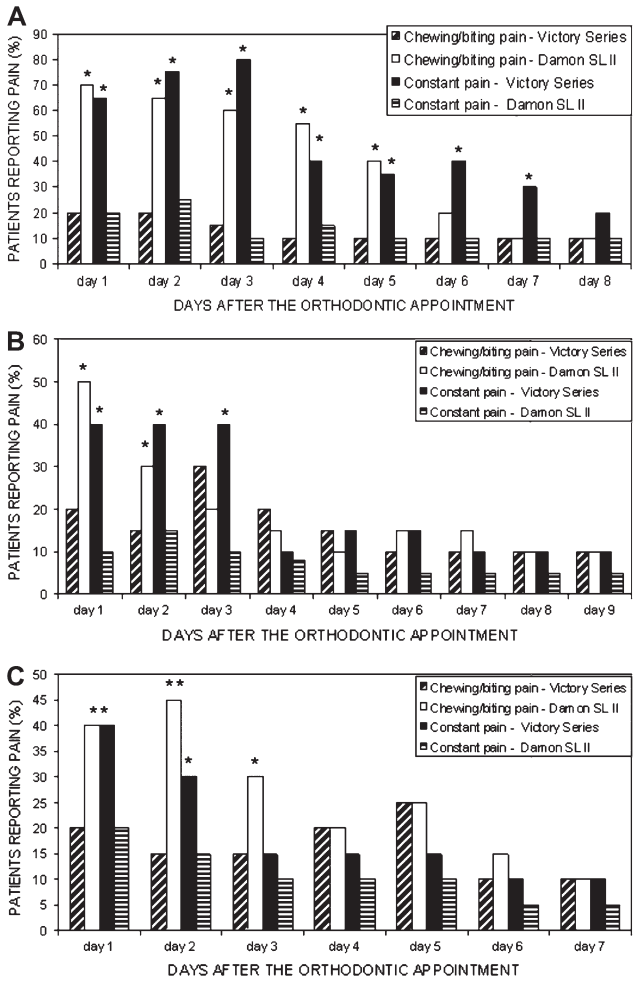

Figure 3 Distribution of pain characteristics according to the type of brackets employed after insertion of the first archwire during (A) the first 8 days of month 1, (B) after activation of the appliance during the first 9 days of month 2, and (C) during the first 7 days of month 3. Significant difference between the two groups are indicated by $*P < 0.05$ and $**P < 0.01$.

In the patients treated with the Victory Series bracket, the majority reported constant pain, which was significantly different from the Damon SL II group for the first seven days of month 1 (Figure 3A), the first three days of month 2 (Figure 3B), and the first two days of month 3 (Figure 3C). In general, patients treated with Victory Series brackets reported significantly less chewing/biting pain than constant pain, when the total mean frequency value was calculated for the follow-up period ($P < 0.05$).

Pain medication

Analgesia was most often used by the patients treated with Damon SL II during the first two days after insertion of the first archwire. The type and dosage of the medication used indicated a moderate need for pain alleviation. Eight per cent of the patients used painkillers on day 1 and 10 per cent on day 2. However, by day 3 all patients had stopped using pain medication (Figure 4A).

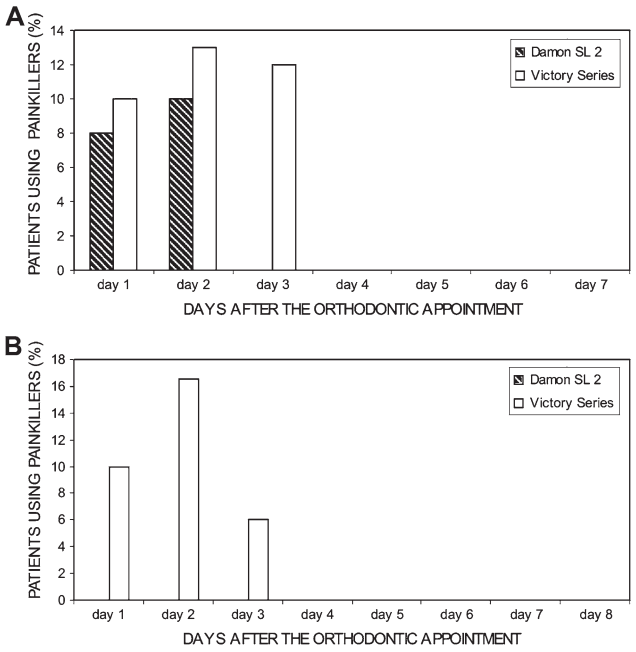

Figure 4 Patients reporting the use of analgesia after insertion of the first archwire during (A) the first 7 days of month 1 and (B) during the first 7 days of month 2. No significant difference was observed between the groups.

In the Victory Series group, pain medication was used during the first three days of months 1 and 2, with a peak of 16.5 per cent on day 2 of month 1 (Figure 4).

No significant differences were observed between the frequency of patients who used painkillers in the conventional and self-ligating groups.

Of interest was that when painkillers were used to a greater extent, the patients also reported higher pain intensity (VAS).

Discussion

All patients in the present investigation had crowding. These inclusion criteria ensured that the type of orthodontic treatment was approximately the same for all subjects in both groups.

The findings seem to indicate that, in general, regardless of the type of appliance used (traditional or self-ligating), pain is higher during the first two or three days after appliance activation. These results are consistent with those of several investigations that evaluated pain associated with orthodontic treatment (Kvam *et al.*, 1987; Ngan *et al.*, 1989; Jones and Chan, 1992a,b; Scheurer *et al.*, 1996; Bergius *et al.*, 2002).

In addition, the results add significant data regarding the experience of pain with traditional or self-ligating fixed appliances. Patients treated with self-ligating brackets recorded significantly lower VAS scores than those treated with conventional brackets (Figure 2), suggesting that lower friction may have an effect on tooth movement and result in less pain. Several studies have demonstrated a significant decrease in friction of self-ligating brackets compared with

conventional brackets (Berger, 1990; Eberting *et al.*, 2001; Harradine, 2001; Thorstenson and Kusy, 2001).

However, the data on the nature of pain is not comparable with previous investigations. It was observed that patients treated with the Damon SL II showed a higher frequency of chewing/biting pain, while those treated with Victory Series brackets reported a higher degree of constant pain. This difference was evident during the first seven days of month 1 and during the first three days of months 2 and 3. As the primary mechanical difference between the two appliances used in this investigation concerned the bracket–archwire interface, this could explain the different nature of pain reported by the patients. As pain during orthodontic treatment is mostly associated with the level of compression of the periodontal ligament, it may be hypothesized that lower frictional forces generate less compression of the periodontal ligament and blood vessels and so alter the type of pain experienced.

With regard to the use of analgesics, when the pain intensity peaked, 10 and 16.5 per cent of the patients in the Damon and Victory Series groups, respectively, used painkillers. These percentages are in agreement with those of Oliver and Knapman (1985) of 16 per cent. In general, analgesics were mostly used by patients who reported a higher intensity of pain.

Conclusions

Patients treated with conventional brackets seem to experience higher and more intense pain and for a longer period than those treated with self-ligating brackets. Patients treated with conventional brackets reported mostly a constant pain, as opposed to a chewing/biting pain, reported by patients treated with self-ligating brackets.

A small percentage of patients used analgesics for 2–3 days after activation of the appliance.

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