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Effectiveness of Wire Composite Splints in Managing Pain and Mobility in Different Luxation Injuries of Permanent Anterior Teeth

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ABSTRACT

Permanent teeth are susceptible to luxation injuries. Different methods of splinting have been used for better healing outcomes. Pain relief, mobility and gingival lacerations come out to be better managed when traumatic teeth are splinted for a required time. **Objective:** To determine the effectiveness of wire composite splints in managing pain and mobility in various luxation injuries. **Methods:** A count of 85 patients meeting the criteria of inclusion were included in the study that was conducted in Pedodontics department at Nishtar Institute of Dentistry Multan from 15th August 2022 to 15th January 2023 in a duration of 6 months. Patients were assessed for pain relief, comfort, and mobility at day zero and then at 7th and 14th day post splinting with 0.4mm wire and composite splints. **Results:** Grade I mobility was improved by 75.3 % and grade II and III mobility were improved by 100% at 14th day. On VRS scale moderate to severe pain was improved by 100% and mild one was by 73% on 14th day. These splints were effective in relieving pain and improving mobility at 7th and 14th day post splinting. Chi square test shows insignificant associations between pre and post splint mobility. **Conclusions:** It comes out that wire composite is not only an easy, at hand and quick method but has made mark for patient comfort, relief of pain, improving and managing mobility of different luxation injuries of young permanent anterior. This popular method of tooth stabilization enjoys its popularity for all the right reasons.

INTRODUCTION

Injuries to a child's teeth are a common reason to take them to the dentist. Over half of all children will experience a dental injury before they turn 18, and those between the ages of 7 and 14 are the most at risk [1]. Men are more likely to be affected than women of the same age group because they participate in more outside activities [2]. Pain, infection, and the possible fracture or loss of the offending tooth(s) are all major consequences of such traumatic injuries. Permanent tooth buds may not develop normally if the primary dentition sustains various types of traumas [3]. Dental traumatic injuries can range from a little chip in the enamel to a complete loss of the tooth, also known as an avulsion. The health of the teeth and the periodontium, which surrounds them, depends on an accurate assessment of the dental hard and soft tissue following any dental damage [4]. The initial step in treating oral hard tissue injuries is determining whether the traumatized tissues require stabilization [5]. However, if the injury was severe enough to affect the periodontium and no mobility has occurred, the Alveolar socket can regenerate its holding capacities without the need for additional stabilization; otherwise, splinting the offending teeth is necessary [6]. The American Association of Dental Traumatology has provided splinting guidelines to aid in this process, which state that splinting the luxated tooth or teeth with accompanying non traumatized teeth for a

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duration of 2 weeks using a flexible splint is recommended for cases without root or alveolar bone fracture, while splinting using flexible splints for a period of 4 weeks is recommended in cases with root or alveolar bone fracture. The American Academy of Paediatric Dentistry has also endorsed these recommendations [7]. Simple splints using composite only, composite and wire splints, fishing line with composite splints, orthodontic bracket and wire splints, fibre splints, titanium trauma splints, arch bar splints and wire ligature splints are just a few of the many methods that have been employed for Dento-Alveolar Splinting [8]. Wire and composite splints are the most known splint types in use these days. Here, the materials employed are resin composite and a wire of specific diameter and it is employed to attach traumatized luxated tooth to its neighbouring sound teeth. Rigidity and flexibility of used wire will be determined by diameter of stainless-steel wire having said that diameter used varies for cases varied among various writers [9-11]. The purpose of this research was to assess the efficacy of oral traumatic injury therapy using composite and wire splints with a stainless-steel wire diameter of (0.4mm).

METHODS

From 15thAugust 2022 to 15th January 2023, with approval from the institute's ethical committee board, researchers at Nishtar Institute of Dentistry Multan conducted a prospective study. The finite population was predicted to be 100 over a six-month period, and the sample size of 80 was determined using Openepi calculator v3 with a level of confidence of 5% and power of test of 80%. Children of either gender who presented to the hospital throughout the study period and who had sustained dental trauma resulting in the mobility (Grade 2 or Grade 3) of one or more permanent maxillary incisors were included. Teeth having root, crown, or alveolar fractures, as well as avulsed teeth, were included in the analysis. Children who were too young at any point in the study to have a follow-up visit were also omitted. Only teeth/teeth that met the criteria were included in the study, even if the child had suffered trauma to more than one tooth. Eighty-five teeth were selected from 80 youngsters who met our inclusion criteria based on clinical and radiographic evaluations. Patients meeting the inclusion criteria were treated with splints consisting of 0.4 mm stainless steel wire adapted to the middle third of the facial surfaces of the traumatized tooth and one healthy tooth adjacent on both sides of it using Light cured Composite Resins. After 24 hours, 7 days, and 14 days postoperatively, patients were contacted for Follow up to remove their splints and assess their progress. During the postoperative check-ups, the patient's level of comfort and factors like mobility of tooth, pain when biting, and lacerations of gingiva were assessed. Grade 0 indicated normal tooth movement, Grade 1 indicated tooth mobility of 1 mm, Grade 2 indicated tooth mobility of 2 mm, and Grade 3 indicated tooth mobility of 3 mm. The severity of the discomfort experienced as a result of being bitten was ranked on a 4-point verbal rating scale (VRS) from 0 to 3, with 0 indicating absence of pain, 1 moderate pain, 2 considerable pain, and 3 extreme pains. Children who suffered from many broken teeth had their VRS pain scale responses and tooth movement recorded independently. SPSS version 20.0 was used for the data analysis. Quantitative and qualitative measures were used to collect the data. Frequencies and percentages were recorded for qualitative variables such gender, VRS pain score, mobility grade, and laceration presence. In contrast to the Mean and Standard Deviation recorded for quantitative data like age, the Chi Square goodness of fit test was employed to determine whether certain qualitative characteristics recorded after surgery were statistically significant.

RESULTS

There was a total of 85 people in this prospective cohort research, with men making up 56.5% (n=48) and women making up 43.5% (n=37) of the sample. Participants ranged in age from 7-12 years old, with an average age of 8.92 ± 1.02. The majority of patients (77.6%; n=66) reported severe pain on the visual analogue scale (VRS) before surgery due to discomfort when biting. The same was true of the subjects, all of whom displayed varying degrees of tooth movement. (Table 1) Table 1 shows demographic data and preoperative variables. Gender distribution in the study shows Males were reported in greater number 56.5% and females were 43.5 %. Severe pain on biting pre op was leading with 77.6%. Grade III mobility pre op was leading with 56.5%.

Table 1: Demographic Data and Preoperative Variables

Pre-Operative Variables		Values Mean ± SD / N (%)
Age		8.92 ± 1.02
Gender	Female	37(43.5)
	Male	48(56.5)
Pain on Biting Pre-op	None	0(0)
	Mild	1(1.2)
	Moderate	18(21.2)
	Severe	66(77.6)
Mobility Pre-op	None	0(0)
	Grade I	2(2.4)
	Grade II	35(41.2)
	Grade III	48(56.5)

Responses of children on VRS pain scale was improved as depicted from table 2. Moderate pain went from 21.2% to 55.3% to 0% at day1,7th and 14th respectively. Severe pain went from 77.6% to 5.9% to 0% at day1, 7th and 14th respectively. Depicting effectiveness of splints in question.

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Table 2: Responses of patients on VRS pain scale on follow up visits

VRS Score for Pain	Day 1	7th Day	14th Day
None	0 (0.0%)	1 (1.2%)	58 (68.2%)
Mild	1 (1.2%)	32 (37.6%)	27 (31.8%)
Moderate	18 (21.2%)	47 (55.3%)	0 (0.0%)
Severe	66 (77.6%)	5 (5.9%)	0 (0.0%)

Mobility of teeth recorded at multiple visits was 41.2%,25.9%,0% at day 1,7th and 14th day respectively for grade II mobility. Grade III mobility went from 56.5% at day 1 to 0% at 7th and 14th day depicted from Table 3.

Table 3: Tooth mobility recorded at multiple visits

Mobility	Day 1	7th Day	14th Day
None	0 (0.0%)	0 (0.0%)	64 (75.3%)
Grade 1	2 (2.4%)	63 (74.1%)	21 (24.7%)
Grade 2	35 (41.2%)	22 (25.9%)	0 (0.0%)
Grade 3	48 (56.5%)	0 (0.0%)	0(0.0%)

Pain, mobility, and gingival laceration were monitored postoperatively for 24 hours, 7 days, and 14 days, respectively (Tables 4).

Table 4: Chi-Square Tests

Mobility	Value	df	Asymp. Sig. (2- sided)
Pearson Chi-Square	8.000	6	.238
Likelihood Ratio	8.318	6	.216
Linear-by-Linear Association	1.980	1	.159
N of Valid Cases	80	-	-

When reading this table, we are interested in the results of the "Pearson Chi- Square" row. We can see here that $\chi(1) = 8.0$, $p = .238$. This tells us that there is no statistically significant association (Tables 5).

Table 5: Symmetric Measures

Mobility	Value	Approx. Sig.
Phi	1.414	.238
Nominal by Nominal	-	
Cramer's V	1.000	.238
N of Valid Cases	4	

Phi and Cramer's V are both tests of the strength of association. We can see that the strength of association between the pre splint mobility and post splint mobility is very weak.

DISCUSSION

Splinting as a treatment option for dentoalveolar injuries is gaining more and more support daily. For optimal periodontal healing, it is best to keep the tooth in its original location while still allowing for some movement. Ankylosis can be prevented, and healthy periodontal ligaments can repair more quickly with the help of functional stimulation. Teeth that are splinted following trauma have a better prognosis than those that are not, according to research. Our research aims to evaluate the utility of splinting dentoalveolar trauma with 0.4 mm stainless steel composite wire. The majority of dental injuries in our sample group occurred between the ages of 7 and 12, according to our findings. Other studies have also reported that this age group is particularly prone to these kinds of injuries [12, 13]. According to these studies, the oldest age group at risk for sustaining a traumatic oral injury is between 8 and 9 years old. However, Vanka *et al.*, study found that the majority of its participants were between the ages of 10 and 13,12 males were shown to be more affected than females in our study [14]. This coincides with the findings of previously published research that pointed to a gender bias in favor of men [15, 16]. Males are often more energetic than females, which may explain why they sustain more injuries in the course of everyday activities. In our study, pain reduction and mobility were both enhanced by day 7 and day 14 compared to day 1. Berthold *et al.*, observed that for a flexible wire and composite splint 0.45 mm wire was most suitable, whereas 0.8 mm to 1.8 mm stainless steel rectangular rigid wire was appropriate for splinting of traumatized teeth, confirming the findings of similar investigations [17]. Results from studies using a human cadaver model have been reported similarly by Franz *et al.*, also, the physiological mobility of splinted teeth was not significantly affected by the adhesive point dimensions. For splinting broken teeth, Kwan *et al.*, concluded that 0.016" (0.4 mm) stainless steel or nickel titanium wire worked best [18, 19]. Comparing study to one conducted in Armed Forces Hospital, Jubail, Saudi Arabia and Farooq Hospital, Lahore Pakistan which aimed at studying effectiveness of wire composite splints shows pain on VRS scale was getting better on 7th, 14th day and 90th day in which all of 38 patients were relieved from pain of mild moderate and severe pain on 90th day. Only mild pain at 14th day for only 5 patients. On 7th day no severe pain only 2 patients reported with moderate pain and 4 were with only mild irritation. The study we conducted a total of 85 patients at 14th day no patient has moderate or severe pain only 27 has mild irritation. On 7th day only 5 had severe pain 47 reported moderate pain 32 has only mild irritation. Considering sample size and material used we consider that study conducted formerly support the effectiveness of splints used in our study. The results of our study support the same. In regards to mobility our study shows physiological movement in 64 subjects and 21 showed grade I mobility out of 85 at day 14th and none has grade II or grade III mobility. Supporting that study at Armed Forces Hospital, Jubail, Saudi Arabia and Farooq Hospital, Lahore, no subject had grade III mobility on 14th day and 14 were with physiological 19 with grade I ,5 with garde II. Both studies are showing improvement in mobility with time post splinting. A case series reported by the Department of Pedodontics and Preventive Dentistry at the Maulana Azad Institute of Dental Sciences in New Delhi showed that

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composite bonded with flexible wire were the most frequent type of splint used [20]. Flexible splints are those whose wires have a diameter of 0.3 mm or less. Comparatively, these are easier on the gums than traditional wire and bracket splints. Splints of this sort are useful for treating both avulsion and luxation injuries. Placing one of these splints is a painless process that has no effect on healthy teeth. It's incredibly relaxing for patients because it aids in keeping their speech and appearance intact and because it's simple to keep up with their oral hygiene. Our research also found that following wire adjustment on day 14, the number of cases of gingival laceration reported on day 7 decreased. This study may have benefited from the inclusion of a control group, which can be done in future research.

CONCLUSIONS

Among various methods of splinting of luxated permanent teeth we considered splinting with 0.4mm wire composite splints which has been widely used. In this clinical trial patients were relieved from pain and mobility was improved at 1st and 2nd week post application of splints. So, wire composite splints are efficient and share their fair contribution in being an easy and effectual mode for stabilizing luxation injuries.

Authors Contribution

Conceptualization: SK, NP, AS
Methodology: SK, AG, MA
Formal Analysis: SK, AG, TM, MA
Writing-review and editing: SK, NP, AG, TM, AS

All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare no conflict of interest.

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