

## Review Article

# Orthodontic Headgear and Ocular Injuries

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### Abstract:

Headgears are the most common among all the dento - facial orthopaedic appliances. This orthopaedic appliance is used in growing children mainly in mixed dentition period. So the incidences of injuries to face, eyes, oral mucosa is more due to accidental disengagement and improper handling of appliance by the children. We can reduce these incidences by using safety modules, locking bows, extra elastics, neck straps, anti recoil devices and by training the patients etc. The proactive suggestions should help to improve patient safety, by increasing the hours of wear and supporting the continued use of a very useful piece of orthodontic equipment.

**Key words:** Headgear, Ocular injuries, Prevention.

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### Introduction:

Headgears are the most common among all the dento - facial orthopaedic appliances. They are used to intercept the developing skeletal malocclusion in growing children. They can be used to stop forward growth of maxilla, distalize the maxillary molars and distalize the maxillary skeleton in extreme cases. Headgear may be used with other myofunctional appliances like activator, twin block. This orthopaedic appliance is used in growing children mainly in mixed dentition period. So the incidences of injuries to face, eyes, oral mucosa is more due to improper handling of appliance by the children. As this is an orthopaedic appliance, the force applied to the growing maxilla is between 400 -1000 gms which is more than orthodontic force so the severity of injuries. A number of cases have been recorded in the literature where personal injuries have occurred as a result of displacement of a face bow while the elastic remain attached to the headgear<sup>1</sup>. The resulting so called catapult injuries can

traumatize the intra oral and extra oral tissues depending upon where or not the face bow is displaced from mouth. Injuries included from simple laceration to oral cavity, face, nose eyelids to severe like eye injuries. In few of cases, serious ocular damage has occurred<sup>1</sup> in the form of penetrating ocular injuries. Penetrating ocular injuries may be asymptomatic but person with minor injury should seek immediate and thorough ophthalmic evaluation as it is contaminated by mix flora from saliva.

### Literature review:

In 1975, the American Association of Orthodontists issued a bulletin on extra oral appliance care. They carried out a survey on the use of headgear by their members<sup>2</sup>. Results were obtained from 4,798 orthodontists who had treated approximately 4.5 million patients using headgear over an average period of 15 years. The preliminary report from this survey revealed that 4% of respondents had experienced headgear injuries in one or

more of their patients and 40% of these injuries were extra oral. However, more than half of the extra oral injuries occurred in the mid face in the region of eyes, eyelids and bridge of nose. A permanent impairment of vision represented 3% of total injuries and two thirds of those suffering from an impairment of vision became blind in the injured eye. In 1982 the AAO published the preliminary results of a survey on the use of headgear<sup>3</sup>. From 4,798 replies, 216 injuries from extra oral traction appliances were reported; of these 133 were intraoral injuries, 31 occurred to lower face, 5 to upper face but not in proximity to the eyes, and 41 injuries occurred around eyes. Of the injuries occurring the region of eyes, 7 cases of permanent damage were reported including 5 instances of total blindness in one or both the eyes. But final results of the survey have never been published.

#### **Classification of cause of injuries<sup>4</sup>:**

The following is the classification of eye injuries based on the information obtained from the reports.

- I. Accidental disengagement when the child was playing whilst wearing the headgear.
- II. Incorrect handling by the child during the fitting or removal of the headgear.
- III. Deliberate disengagement of the headgear caused by another child.
- IV. Unintentional disengagement or detachment of the headgear whilst the child was asleep.

#### **Why these injuries are significant?**

There are several very important factors associated with face bow injuries.

- a. The presence of the oral micro-organisms on the ends of the inner bow radically alters the outcome of the soft tissue trauma, making the patient highly susceptible to infection.<sup>5,6,1,7</sup>
- b. Surprisingly, face bow injuries to the eye can cause little pain at the outset often delaying the child seeking treatment especially when it occurs at

night. This delay allows the infection to proceed further.

- c. The eyeball is also an excellent culture medium and when it becomes infected it is very difficult to control.
- d. When one eye is injured there is risk to the other undamaged eye from a process called sympathetic ophthalmitis.
- e. The distance between the arms of the inner bow is more or less equal to the distance between two eyes so there more chances of injuries to both the eyes and damage to them.

#### **System failures**

When assessing the failures in safety systems it should be remembered that they can arise from two reasons:

1. Active failures – These are the unsafe acts sometimes committed by the people who are in direct contact with the patient.
2. Latent condition – these are the inevitable ‘residual pathogen’ within the system and arise from decision made by designer.

Unlike the active failures, latent condition can be identified and treated before an adverse event occurs. This understanding leads to proactive, rather reactive risk management.<sup>8</sup>

#### **Assessing the safety issues:**

In order to try and help prevent these injuries and improve safety standard, different manufacturers have introduced several safety devices. Safety headgear products are based on one of the following:

1. Insertion of safety release mechanism so that the face bow will disengage from the traction of excessive force applied.
2. Adjustment of the face bow design (Fig. 1 and 2) to be non traumatic in the event of displacement.
3. Fitting an additional component to prevent the face bow becoming dislodged from the intraoral tubes.

#### **Self releasing headgear and neckgear**

The self releasing mechanism in these devices has been designed to prevent or reduce the catapult effect encountered in

the recoil injuries. The self releasing modules (fig. 3) are manufactured in a different designs.<sup>9, 10</sup>



**Figure 1:** Recurved loops



**Figure 2:** Reversed entry that prevent the disengagement of face bow



**Figure 3:** Safety module

These modular system can be used as either head cap or a neck strap. To reduce the catapult effect to a minimum, the travel provided by these modules should enable a comfortable range of head movement by the patient without unintentional release. The force required to release the module is more difficult to resolve as this will be affected by several factors, such as consistent design quality of modules, axial or non axial distraction force, and the length of outer bow.<sup>11, 12</sup> The self releasing extra oral traction system can reduce the catapult effect to approximately 10 mm for the head cap and 25 mm for the neck strap,

but cannot be relied upon to keep the face bow in place at night.

**Plastic Neckstraps:**

These plastic neck straps (fig. 4) have been offered as a simple safety device presumably to retain the face bow within the buccal tubes. Because these straps are not flexible, it cannot accommodate the changing distance between the back of the neck and face bow, and still provide a continuous resistance to the displacement of the face bow from the buccal tubes.<sup>13, 14, 15, 16</sup> When fitted tightly around patients neck it is either very restrictive or too loose, depending on the position of patients head. Poor patient compliance with this strap has also been reported. The stiff nature of this simple device makes it unsuitable as a reliable method of retaining the face bow within the tube housing when fitted around the neck.



**Figure 4:** Neck strap

**Shielded face bow:**

Some face bows have had shielding included on their inner ends in an attempt to reduce the severity or risk of soft tissue trauma. The design relies on assumption that on recoiling the shielding will always contact the soft tissue first, which cannot be always relied upon. The shielding does not improve the face bows self retentive capability and it can disengage at night in a similar fashion to the standard face bow. Shielded face bow (fig. 5) may reduce the severity of some trauma, but it does not self retentive, which makes this an undesirable alternative to the standard face bow.



**Figure 5:** Shielded face bow

### Locking orthodontic face bow

A standard orthodontic face bow relies on the head cap or neck strap, and any incidental friction in the buccal tube housing to hold it in place. Both of these factors are known to be unreliable.<sup>13,18,19</sup> To maintain the face bow reliable within the buccal tube at night would require an alteration to standard face bow or the buccal tube to provide some active self retentive capability. Nitom Locking face bow (fig. 6 a, b), Ortho Kinetics Corporation, Suite 16, Vista are the some examples of locking orthodontic face bows. There are number of possible design of locking face bow, one of which has been described by Samuels et al in 1993, in that design the locking catch can be constructed by stainless steel wire of 0.8 mm diameter which is soldered to the inner bow.



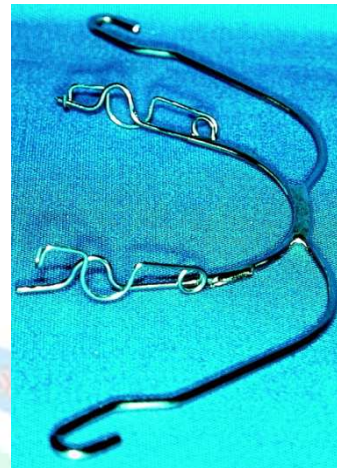
**Figure 6(a):** Nitom Locking face bow

### Safety face bow

These are produced by Lancer Pacific, face bow incorporates a recurved reverse entry safety device on the inner bow and there is no sharp end on either the outer and inner bow, so that if it should spring out a penetrating injury is unlikely. This is an excellent idea, but they are difficult to fit.

Also it is not easy to instruct the patient on how to insert the bow.

The Northwest face bow is based on the same idea but the guard on inner bow is separate from inner bow itself making easier to fit than the Lancer Pacific version. However outer bow has a sharp end which needs to be modified. Neither of these are significantly more expensive than a standard face bow.



**Figure 6(b):** Nitom Locking face bow

### Intra oral elastic attachment

The wearing of elastic from an additional hook on the molar bands relies on the child placing the elastic and locating it correctly. When in place it does not necessarily counter the elastic recoil risk, but rather may add to it. However, such a device may prevent unintentional disengagement at night.



**Figure 7:** Snapaway high pull headgear

### Anti recoil devices

Safety headgear of the 'snapaway' (fig.7) variety can vary in the amount of force and the length of travel required to cause their release mechanism.<sup>9</sup> A short travel with suitable force should avoid the recoil

injuries, accidental disengagement, incorrect handling or undesirable disengagement by another child. However, it will not counter the problem of unintentional release during sleep.

### Miscellaneous safety products

There are two products in this category:

The Nola system is completely different from all the other system. Here, the release mechanism for allowing immediate separation of headgear from face bow is attached to the face bow, unlike all the other system where the release mechanism is attached to the headgear. This is a very attractive idea because it allows immediate conversion of any headgear / face bow combination to a safer system. Attaching the 'Freedom Latch Unit' to the face bow however, is time consuming and attaching the 'Safety Line' is fiddly, but both of these can be done by the technician in advance of the fitting appointment.

Masel safety strap: This is the simplest, quickest and cheapest way of converting any headgear to a safer version. It works by limiting the possible movement of the face bow. The Masel safety strap is added to the patients existing headgear system by sliding it under the neck strap and running it in parallel.

### Proactive risk management

Extra oral traction should only be prescribed to those patients who are likely to comply with the orthodontist's instruction. The use of the equipment should be clearly demonstrated to the patients and the parents. A written consent has to be obtained from patient or from parents. It is important to instruct the parents in case of young, less dextrous or poorly sighted patients. Written instruction should be issued to all patients and parents to take away with them. The instruction should include the following detail;

- 1) Patients should be advised never to wear their headgear during playful activities.
- 2) Should use mirror at the time of wearing of appliance. (fig. 8)



**Figure 8:** Insert inner bow in mouth first then engage it with force element

- 3) Should another individual grab their face bow, the patient should also take hold of it until another person has released their hold. They should then dismantle the head cap / neck strap, and face bow to check out that nothing has been dislodged or broken.
- 4) Always fit the locking face bow first. When the locking face bow has been fitted, patient should check in mirror to make sure it is seated correctly and then confirm the 'lock' with gentle forward pull. Once the face bow is in position then the self releasing head cap / neck strap may be fitted, whilst holding on to the face bow, to the prescribed tension as shown by the orthodontist.
- 5) If the head cap / neck strap / face bow ever comes off at night or there are any other problem, the patients should stop wearing the appliance, and return to see the clinician as soon as possible.
- 6) If the patient experiences a problem unlocking or removing the face bow, excessive force should not be used to remove it. The face bow should be left in place and the patient should attend the orthodontic practice as soon as possible to allow the orthodontist to rectify the problem.
- 7) Before removing the face bow the patient must first remove the head cap / neck strap.
- 8) If the patient wake up and removes the head cap /neck strap and face bow in middle of the night, they should place it outside the bed before going back to sleep.

- 9) The patient and parents should also be advised that, 'if in the rare and unlikely event, they suspect the part of the head cap / neck strap / face bow might have caused an injury to eye, then eye should be examined without delay by a suitably trained medical practitioner.

#### **Clinical tips**

- 1) Before fitting the face bow on the patient demonstrate and describe its function on a model of an upper arch with molar bands, which gives a patient a clear idea of what is required.
- 2) When fitting the correct size of face bow on the patient, place the both the ends of inner bow in the mouth with the catch unlocked. Insert the first end in to the buccal tube. Some operators like to engage the first catch at this stage as they feel this tends to stabilize the face bow.
- 3) Apply no expansion to the inner bow at the first fitting, as it makes it much easier for the patients to insert the second side in to the buccal tube.
- 4) Some practitioners prefer to teach the patient to remove the face bow, rather than fit the face bow as the first task. They feel their patients learn to use the face bow quicker in this manner.
- 5) Other practitioner prefer to demonstrate and fit only the locking face bow at first visit and with hold the extra oral traction. The patient can then practise fitting and removing the locking face bow at home with their parents help if required. On the subsequent visit to the orthodontist, the patient can demonstrate fitting the face bow, and then the head cap or neck strap is issued to the patient.
- 6) A few patients like to play with the catches. Advise them against doing this because eventually the wire will harden and break.
- 7) During space closing sliding mechanics in the upper arch, when arch wire tends to appear behind the upper first molars, the face bow can be turned over, so that the ends of catches don't get trapped on or under the arch wire ends. This can make

it different for the patient to disengage the catch.

#### **Discussion**

Patients wearing the headgear should be issued with written instruction on how to fit headgear and warned of the possible danger of injuries. This should include the warning that they should seek advice from an ophthalmologist immediately if eye injury occurs, even if it is asymptomatic, as delay leads to complications.

Unfortunately, no method can confer absolute safety, but because headgear are able to cause serious injuries, which can have irreversible consequences for the patients, and serious medico legal consequences for the clinician, it would seem wise to use a safety face bow together with safety release system to improve the safety margin of headgear.

#### **Conclusion**

The patient's instructions are designed to reduce the risk of injuries as a result of horseplay or incorrect fitting. The locking face bow is designed to counter the mild, moderate forces of accidental disengagement of the face bow at night, and will provide moderate resistance to unintentional disengagement. It should also improve the hours of wear achieved by some patients. The self releasing head cap or neck strap should prevent the recoil traction if a large anterior displacing force from another child overrides the locks of the face bow. These proactive suggestions should help to improve patient safety, by increasing the hours of wear and supporting the continued use of a very useful piece of orthodontic equipment.

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