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COMPLICATIONS OF ORTHODONTIC TREATMENT- A LITERATURE REVIEW

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ABSTRACT

Orthodontic treatment is usually associated with certain complications and limitations. The risks of orthodontic treatment include periodontal damage, pain, root resorption, tooth devitalization, temporomandibular disorder, caries, speech problems and enamel damage. This article briefly describes about the complications associatedwith orthodontic treatment.

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INTRODUCTION

Like any other medical intervention, orthodontic treatment has, in addition to its benefits, also associated risks and complications. In orthodontics, the risk of "doing harm" is considerably lower compared to other medical interventions, e.g., the surgical ones. Orthodontic treatment of malocclusions and craniofacial abnormalities, by ensuring proper alignment of the teeth, harmonious occlusal and jaw relationship, may improve mastication, phonation, facial aesthetics, with beneficial effects on the general and oral health, individual's comfort and self-esteem, having a positive role in improving the quality of life. Therefore, the treatment's objectives are consistent with the aims of medical interventions, namely ensuring health, the "state of complete physical, mental and social well-being[1]. Usage of various procedures, devices and materials, there might appear unwanted side effects, both local (tooth discolorations, decalcification, root resorption, periodontal complications) and systemic (allergic reactions)[2]. It is important to assess the risks of treatment as well as the potential gain and balance these aspects of treatment before deciding to treat a malocclusion[3].

Key points to note are[3]:

- Before any active orthodontic treatment is considered it is essential that the oral hygiene is of a high standard and that all carious lesions have been dealt with.
- Archwires, headgears and brackets may cause significant damage during an active phase of treatment or during debonding. Must care needs to be taken when instructing patients about their role in orthodontic treatment.

CLASSIFICATIONS

Graber (Graber et al., 2004) [4]:

Based on the condition'slocalization

- Local effects, with manifestation on dento-maxillary apparatus structures (enamel demineralizationsand discolorations,root resorption, gingivitis).

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- Systemiceffects (allergicreactionstonickelorlatex).

According to the condition'sseverity:

- Mild, reversible(gingivitis);
- Moderate, reversible (fracture of a ceramiccrown);
- Moderate, irreversible (enamel fracture duringdebonding);
- Severe, irreversible (multiples caries and decalcifications, severe rootresorption).

Based on orthodontist's role in the side effect's occurrence:

- Standard inherent complications, eg; enamel changes due to acid etching when resins are used as bonding material.
- Complications related to the patient's particularities, eg; allergic reaction for which history data was inconclusive, severe root resorption and demineralization present in association with a metabolic disease unidentified at the initial assessment.
- Medical errors by wrongful medical objectives and deficient treatment conduct, eg; enamel damage due to improper debonding technique, tooth movement into an area with alveolar bone defect causing severe loss of attachment.

Also classified into:

- Intra oral complications.
- Extra oral complications.

Systemic complications

INTRA- ORAL COMPLICATIONS[5]

- Enamel demineralization/ caries.
- Enamel trauma.
- Enamel wear.
- Pulpal reactions.
- Root resorption.
- Periodontal problems.
- Allergic reaction.
- Gingival inflammations and trauma.

Enamel demineralization/ caries

- Enamel demineralization, usually on smooth surfaces, is unfortunately a common complication inorthodontics.
- The teeth most commonly affected are maxillary lateral incisors, maxillary canines and mandibularpremolars[6].
- However, any tooth in the mouth can be affected, and often a number of anterior teeth showdecalcification.
- If the demineralized surface remains intact, there is a possibility of remineralization and reversal of thelesion. In severe cases, frank cavitation is seen which requires restorative intervention.
- Gorelick et al. in a study on white spot formation in children treated with fixed appliances, found that half of their patients had at least one white spot after treatment, most commonly on maxillary lateral incisors. The length of treatment did not affect the incidence or number of white spot formations.
- Results of a recent meta-analysis have demonstrated that in the 14 studies evaluated for WSLs, the occurrence of WSLs is common during fixed orthodontic treatment with an incidence and prevalence rate of 45.8 and 68.4%. It has been proposed that the risk of developing WSLs during orthodontic treatment should not be underestimated by orthodontists, necessitating the search for further methods to counter the risk of development of these lesions[7].

Preventive measures

- The dominant hand may also influence the area of decalcification as brushing is more difficult on the side of the dominanthand.
- Whilst good oral hygiene is vital, dietary control of sugar intake is also needed in order to minimize the risk ofdecalcification.
- Fluoride mouthwashes used throughout treatment can prevent white spot formation surprisingly, compliance with this is low (13%).
- Other fluoride release mechanisms include fluoride releasing bonding agents, elastic ligatures containing fluoride, and depot devices on upper molarbands.
- Where demineralization is present post treatment, fluoride application either via toothpaste, or by adjunct fluoride mouthwash (0.05% sodium fluoride daily rinse or 0.2% sodium fluoride weekly rinse), can be helpful in remineralizing the lesion and reducing the unsightliness of the decalcification.
- Acid/pumice micro abrasion has also been advocated to improve the aesthetics of stabilised lesions[8].
- Persistent lucencies should be abraded with 18% hydrochloric acid in fine pumice under rubber dam in bursts of 30 seconds for a maximum of 10 times[9].
- After the last application the tooth is washed well and a fluoride varnish applied.

Enamel trauma

- When placing appliances careless (eg: use of a band seater) can result in enamelfracture.
- Care is required when large restorations are present since these can result in fracture of unsupported cusps.
- Debonding can also result in enamel fracture, both with metal and ceramic brackets[10].

- Care must always be taken to remove brackets and residual bonding agents appropriately to minimise the risk of enamel fracture.
- The use of debonding burs has the potential to remove enamel, especially in air turbine fast handpieces[11].
- Care and attention is needed when adhesives are removed.

Enamel wear

- Another dental alteration present in the orthodontic patient is tooth wear secondary to the contact between teeth and brackets or tubes.
- A higher gravity of this process was noticed when ceramic brackets are used, Viazisreporting a severity from 9 to 38 times higher compared to the metallic ones (Lau et al., 2006; Viaziset al., 1990).
- It is recommended, especially during certain phases of orthodontic treatment, to avoid usageof ceramic brackets in order to minimize the dental wear, as an irreversible treatment complication[12].
- Any enamel erosion must be recorded prior to treatment commencing and appropriate dietary advice given to minimise further tooth substance loss.
- Carbonated drinks and pure juices are the commonest causes of erosion and should be avoided in patients with fixed appliances.

Upper canine tip showinq abrasion front the lower canine metal braket

Pulpal Reactions

- Some degree of pulpitis is expected withorthodontic tooth movement which is usually reversible or transient.
- Rarely it leads to loss of vitality, but there may be an increase in pulpitis in previously traumatized teeth with fixedappliances.
- Light forces are advocated with traumatized teeth as well as baseline monitoring of vitality which should be repeated threemonthly.
- Transientpulpitismayalsobeseenwithelectro- thermal debonding of ceramic brackets and composite removal at debonding[13].

Root resorption[14]

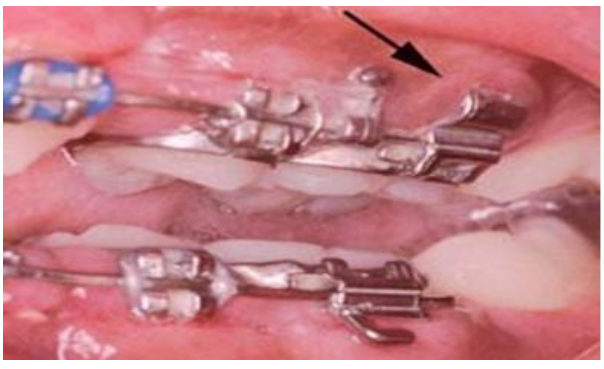
- Apical root resorption is, according to the present knowledge, an unavoidable complication of the orthodontic treatment.
- Resorption may occur on the apical and lateral surface of the roots.
- Root resorption's signs and symptoms are usually absent, even mobility been rarely higher than 1st degree on the Miller scale.
- In the end of the treatment the root resorption's severity is mild or moderate the tooth prognosis doesn't greatly decrease.
- The mechanism of tooth resorption is unclear.
- Theories include excessive force and hyalinization of the periodontal ligament resulting in excessive cementoclast and osteoclast activity.
- The risk factors which are associatedwith cases with severe resorptionare:
  - Blunt and pipette shaped roots show a greater amount of resorption than other rootforms.
  - Short roots are more at risk of resorption than average lengthroots.
  - Teeth previously traumatized, have an increased risk of further resorption.
  - Non vital teeth and root treated teeth have an increased risk of resorption.
  - Heavy forces are associated with resorption, as well as the use of rectangular wires, Class II traction, the distance a tooth is moved and the type of tooth movement undertaken.
  - Combined orthodontic and orthognathic procedures.
  - Tooth intrusion is also associated with increased risk as well as movement of root apices against corticalbone.
  - Adults have shorter roots at the outset and the potential for resorption isincreased.
  - Root resorption is inevitable with fixed appliancetreatment.
  - On average 1–2 mm of apical root is lost during a course of orthodontictreatment.

Once resorption is recognised clinically during treatment,

- Light forces must be used
- Root length monitored six monthly with radiographs
- Treatment aims reconsidered to maximise the longevity of the dentition.

Periodontal Problems[15]

- Fixed appliances make oral hygiene difficult even for the most motivated patients, and almost all patients experience some gingivalinflammation.



Inflammation covers head gear tube and upper molarband.

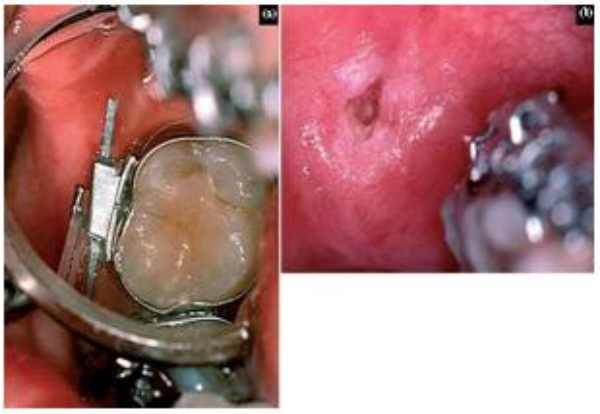
- Resolution of inflammation usually occurs a few weeks after debond.
- Bands cause more gingival inflammation than bonds, which is not surprising since the margins of bands are often seated subgingivally.
- Gingivitis usually occurs due to the incorrect maintenance of the oral hygiene, inthe presenceof the orthodontic appliance, that seems to favor plaque accumulation.
- Their frequency is increased in some particular situations, like in the presence of orthodontic bands that usually are placed subgingival, accompanied sometime by the solubilisationof luting agent, favoring the gingival overgrowth by mechanical trauma and existence of retention space for plaque accumulation.
- Research has shown that during orthodontic therapy gingival enlargement occurs, but approximately 3 monthafter the removal of the appliance, in most cases, the gingiva presents a similar aspect as before treatment.
- Oral hygiene instruction is essential in all cases of orthodontic treatment, and the use of adjuncts such as electric toothbrushes, interproximal brushes, chlorhexidine mouthwashes, fluoride mouthwashes and regular professional cleaning must be emphasised.
- However, patient motivation and dexterity are paramount in the success of hygiene.
- Experience shows those patients who are unable to maintain a healthy oral environment in the absence of fixed orthodontics will fail spectacularly with braces in place. Benefit must therefore significantly outweigh the risk of carrying out treatment in such patients[16].

Allergic Reactions[17]

- Hypersensitivity reactions can occur associated to the well knownallergens like nickel, cobalt, chromium, latex and polymers. The most frequent form is the contact dermatitis of the face and neck, but lesions can appear also on the oral mucosa and gingiva, and rarely even systemic reactions mayoccur.
- Nickel allergies are the most frequent ones in the industrialized countries, manifesting usuallyas a type IV hypersensitivity reaction. Orthodontic devices contain approximately 8% nickel and the nickel-titanium alloy near 70% nickel.
- The allergic signsmay vary from small rash on skin or mucosa, to generalized dermatitis. In high severitycasesthemanifestationsmayleadtodiscontinuationof theorthodontictreatment.
- Another allergen taken into consideration when orthodontic treatment is performed is latex (from medical gloves, elastomeric ligatures, elastic chain, rubber dam etc).
- Prevalence of latex related allergies is reported as being lower than 1% in the general population, but greater than 5% among dental professionals [18].
- Associated to it, types I and IV hypersensitivity reactions may appear, the most severe one, type I, being life threatening[18].
- As a result of toxic, carcinogenic, allergic properties of nickel led to the development of nickel free alloys.
- Alternatives to NI-TI include fibre- reinforced composite arch wire, TMA wire etc.
- Ion- implanted NI-TI archwires have their surface bombarded with nitrogen ions, which forms an amorphous surface layer, conferring corrosion resistance and displacing nickel atoms and decreasing the risk of allergic response.

8. Trauma[19]

- Laceration tothe gingivae, and mucosa seen as areas of ulceration or hyperplasia, often occur during treatment or between treatment sections from the archwire and bonds, especially where long unsupported stretches of wire rest against the lips.
- The use of dental wax over the bracket may help to reduce trauma and discomfort, as may rubber bumper sleeving on the unsupported archwire.



EXTRA ORAL COMPLICATIONS.

- Allergy.
- Trauma.
- Burns.
- Temparomandibular dysfunction.

Allergy[20]

- Allergy to nickel is more common in extra-oral settings,most usually the headgear face bow or head strap.
- The use of sticking plaster over the area in contact with the skinis sufficient to relieve symptoms. Allergy to latex and bonding materials has been reported although these arerare.

Nickel allergy (contact dermatitis in a headgear wearer

Trauma

- Following a well publicized case of eye trauma in a patient wearing headgear a number of safety headgear products have been designed and explicit guidelines are nowavailable[21].
- These measures include safety bows, rigid neck straps and snap release products to prevent the bow from disengaging from the molar tubes or acting as aprojectile.
- Eye injury is uncommon, but a serious risk and all available methods of reducing the risk of penetrating eye injury must be used.

Burns

- Burns, either thermal or chemical are possible both intra- and extra-orally with inadvertent use of chemicals or instruments.
- Acid etch, electrothermal debonding instruments and sterilised instruments which have not cooled down all have the potential to burn and care should be taken in theiruse.

Temperomandibular dysfunction[22].

- Post orthodontic allytemop oromandibular disorders are usually part of the cranio-mandibular dysfunction, which includes beside joint modifications also muscle and dental impairments.
- By the current research knowledge, it isn't clearly elucidated the relation between temporomandibular alterations and orthodontic intervention, usually being found contradictory opinions, explication varying. Some sustain that, by the state of morpho- functional equilibrium present after orthodontic intervention, optimal conditions for this side effects prevention are created. Other believe that, because of the premature occlusal contacts present during therapy, there is a greater risk for this complication to appear.
- Somepatients may suffer with increased symptoms during treatment which must also be discussed at the beginning of treatment.
- Where patients experience symptoms during treatment, treatment should be directed at eliminating occlusal disharmony and joint noises whilst reassuring the patient.
- Standard treatment regimes may also beindicated e.g. soft diet, jaw exercises.

Systemic Complications

- Cross infection.
- Infective endocarditis.

Cross infection[23]

- Spread of infection between patients, between operator and patient and by a third party should be prevented by cross infection procedures throughout thesurgery.
- Use of gloves, masks, sterilized instruments and 'clean' working areas areparamount
- A medical history must be taken for every patient to determine risk factors, although cross infection control should be of a standard to prevent cross contamination regardless of medicalstatus.

Cross infections can be controlled by[23]:

- Protective dressing, masks, gloves, and glasses are to be worn by the dentist (universal barriers).
- Proper washing of the hands before donning gloves is necessary. Damaged gloves should be changed immediately.
- Proper cleaning of reusable instruments before sterilization by a nurse with appropriate protective clothing and proper education is necessary.
- Safe storage of sterilized instruments in covered trays or pouches is to be done.
- Minimization of dirty working areas and proper cleaning and disinfection of working areas after each patient's visit are obligatory.
- All sharp items that may be contaminated with blood/saliva are to be disposed off in the sharp boxes, which should be disposed off when two thirds full.
- All clinical waste should be thrown in a designated bag; when the bag is two thirds full, it should be securely fastened and disposed off in a designated area.
- Proper rinsing and disinfection of all impressions and technical work that are to be sent back to the dental laboratory are obligatory.
- Reaction/allergy to chemicals must result in immediate disposal of corresponding substance.

- Reaction/allergy to latex should be addressed with the use of non latex gloves.

2. Infective endocarditis[24]

- Infective endocarditis (IE), an infection of the endocardial surface of the heart, including the heart valves, the mural endocardium, and the septum, has serious and life-threatening implications.
- A necessary prerequisite for the development of IE is bacteremia.
- Endothelial damage and high pressure or turbulent blood flow attracts fibrin and platelets, which create a nonbacterial thrombotic endocarditis.
- Blood-borne microbes adhere to and replicate within the nonbacterial thrombotic endocarditis, which protects the organisms from host defense mechanisms.
- Resulting in several life-threatening complications, such as ischemic stroke, cerebral hemorrhage, mycotic aneurysm, brain abscess, and meningitis.
- IE generally presents with a broad range of nonspecific, flu-like symptoms, most often with fever (90% of cases) and a heart murmur (85% of cases).
- Other symptoms range from general malaise with loss of appetite, unexplained weight loss or tiredness, headaches, backache, paleness, confusion, shortness of breath, joint pain, weakness in the face or limbs to signs of systemic toxicity.
- Some classic symptoms include cutaneous signs such as petechiae and splinter hemorrhages under the nails (red to brown in color and linear) and splenomegaly.
- Infective endocarditis is rarely associated with the orthodontic interventions, but if it does, it can present severe complications that can be life threatening.
- The American Heart Association recommends prophylactic methods in order to prevent infectious endocarditis appearance if the patient presents prosthetic cardiac valve, previous infective endocarditis, congenital heart disease and cardiac transplantation with cardiac valvulopathy.
- The prophylaxis is mainly indicated in dental procedures that belong to oral and maxillofacial surgery, endodontics and periodontics, routinely in orthodontics being no need to implement it.
- Prophylactique therapy may be indicated in some particular orthodontic phases, where bleeding during interventions occur (e.g., teeth extraction, mini-implant placement used for anchorage control, interventions of orthognathic surgery and sometimes during placement and removal of orthodontic bands).

CONCLUSION

- In conclusion, the risks associated with orthodontic treatment are a reality, complications being a result of a multifactorial process, including aspects related to patient, orthodontist andthetechnicalfeaturesoforthodonticappliancesandproce dures.Thesecanbeprevented or limited through identification and implementation of best treatment alternative for each individual case.
- Patient's compliance is an important factor that can contribute to a high standard outcome, with minimum side effects.

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