





▶ **Good morning**

INTER DEPARTMENT DISCUSSION
ORAL SURGERY AND CONSERVATIVE DENTISTRY
& ENDODONTICS

TRANSPORT MEDIA

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Contents

- ▶ Introduction
- ▶ Need for storage media
- ▶ Ideal characteristics
- ▶ Classification
- ▶ Media in detail
- ▶ Selection of media
- ▶ Treatment protocol
- ▶ Intra canal Medicaments
- ▶ Splints
- ▶ Potential areas
- ▶ Conclusion



References

- ▶ Extra-Alveolar Storage Media for teeth: A Literature review.

IJAR (2014), Volume 2, Issue 7, 963-972

- ▶ Storage media for avulsed tooth a review

Indian Journal of Multidisciplinary Dentistry, Vol. 3, Issue 3, May-July 2013

- ▶ A multiparametric assay to compare the cytotoxicity of different storage media for avulsed teeth

Braz J Oral Sci. April | June 2013 - Volume 12, Number 2

- ▶ Clinical implications of storage media in dentistry

ENDO (Lond Engl) 2010;4(3):179–188



-
- ▶ Multidisciplinary Treatment Options of Tooth Avulsion Considering Different Therapy Concepts

The Open Dentistry Journal, 2014, 8, 180-183

- ▶ *P. F. DAY & T. A. GREGG*. Treatment of avulsed permanent teeth in Children.

UK National Clinical Guidelines in Paediatric Dentistry

- ▶ Kahler. An evidence-based appraisal of splinting luxated, avulsed and root-fractured teeth.

Dental Traumatology 2008; 24: 2–10.





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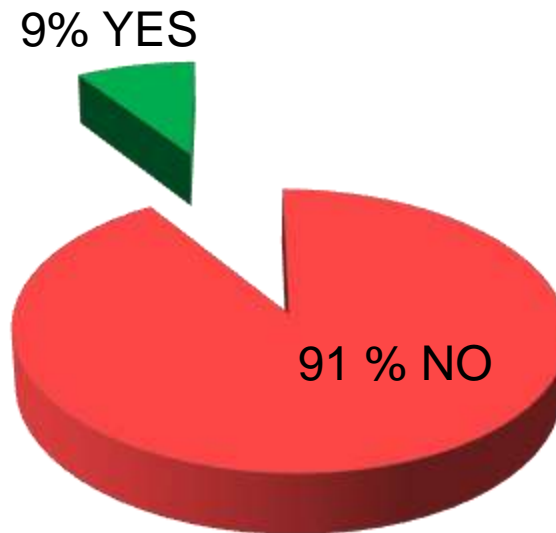
Avulsion

- ▶ Complete and total displacement of tooth from its socket
- ▶ 0.5 to 16% of dental trauma

- ▶ Prognosis depends on
 - 1) Extra alveolar time
 - 2) Preservation of root structure
 - 3) storage media



Awareness about transport media



- ▶ A study to evaluate the level of awareness and knowledge of regarding tooth avulsion among the primary contact doctors was conducted

J Indian Assoc Pediatr Surg. 2013 Apr-Jun; 18(2): 93.


doi: [10.4103/0971-9261.109368](https://doi.org/10.4103/0971-9261.109368)

PMCID: PMC3687158

Awareness about management of 'avulsed teeth' among primary contact doctors

[Vishal Khandelwal](#), [Anupam Gupta](#), and [Sushma Khandelwal](#)

Need for storage media

- ▶ Immediate replantation is recommended
- ▶ person's conscious state
- ▶ lack of first aid knowledge  **not always feasible**
- ▶ informed consent issue
- ▶ extra alveolar time always exist
- ▶ Risk of loss of PDL cell vitality



Ideal storage media

- ▶ Capable of preserving cellular PDL (viability)
- ▶ Promotes mitogenicity
- ▶ Non toxic
- ▶ Preserve functional capabilities
- ▶ Osmolality 290-330 mOsm/L * (critical role)
- ▶ pH of 6.6 to 7.8.*

*Blomlof L. 1981. Milk and saliva as possible storage media for traumatically exarticulated teeth prior to replantation. Swed Dent J, 8: 1–26



Ideal container

- ▶ with internal walls - soft material
- ▶ Sterile
- ▶ removal of the tooth easy without any trauma

STORAGE MEDIA

Natural

Synthetic

**GOOD
ACCESSIBILITY**

**POOR
ACCESSIBILITY**

**GOOD
ACCESSIBILITY**

**POOR
ACCESSIBILITY**

Milk
Coconut
water
Egg white
Water
Saliva

Red mulberry
Propolis
extract
Green tea
extract
Honey milk
Aloevera
pomegranate
juice
Salvia extract

Normal
saline
Gatorade
Contact lens
solution
ORS
Ricetral

Autologous
serum
Probiotics
HBSS
Cryoprotectives
Culture media
Organ storage
fluids
Specialized kits
Additives

Based on cell viability

Intermediate (upto 1 hr)

- Saliva
- Normal saline
- Gatorade
- Tap water

Short term (2 to 6 hrs)


- Milk
- Propolis
- Green tea
- Coconut water
- Egg white
- ORS
- Red mulbery

Long term (24 to 48 hrs)

- HBSS
- Viaspan
- Custodiol
- MEM
- Viaspan
- Eurocollins
- Additive supplemented media



Natural storage media



Milk and milk substitutes

Contents of significance

- ▶ Amino acids
- ▶ Carbohydrates
- ▶ Essential nutrients

Long life milk is more advantageous
Better than saliva and tap water
pasteurized better
Low fat milk preferable

Storage period limit

Milk products upto 4 hours

Milk up to 8 hours



Milk as an interim storage medium for avulsed teeth

▶ PEDIATRIC DENTISTRY: Volume 5, Number 3

Honey milk

- ▶ Contents of significance
- ▶ essential amino acids, vitamins and minerals

Nourishes cells

Maintains viability

Better than fresh milk

Added bacteriostatic nature

Storage period limit

Upto 8 hours comparable to HBSS



-
- ▶ Evaluation of the long-shelf life honey milk As a storage media for preservation of avulsed teeth

Green tea extract: (*Camellia sinensis*)

▶ Contents of significance

Antioxidants (catechins)

Anti inflammatory, anti oxidant
Better than milk

Storage period limit

Upto 24 hours with 90% cell viability
(comparable to HBSS)



The Use of Green Tea Extract as a Storage Medium for the
Avulsed Tooth

▶ JOE — Volume 37, Number 7, July 2011

Coconut water:full concentration

▶ Contents of significance

vitamins, minerals, amino acids, carbohydrates, antioxidants, enzymes, phyto nutrients

Similar osmolality to body fluids

Increases mitogenecity

Economical & Easily available

Full concentration is better

Storage period limit

Upto 8 hours with pdl cell viability comparable to

HBSS

Gopikrishna V, Baweja PS, Venkateshbabu N, Thomas T, Kandaswamy D. Compar

▶ Propolis, HBSS, and milk on PDL cell survival. J Endod 2008;34:587-589



Red mulberry

- ▶ Contents of significance

flavonoids, alkaloids and polysaccharides



- ▶ Storage period limit

for up to 12 h, better than that of HBSS

Aloe vera (liliaceae)

- ▶ Contents of significance

75 active ingredients such as vitamins, enzymes, minerals, sugars, salicylic acids, and amino acids

increases fibroblast activity
collagen proliferation



- Storage period limit

- ▶ 10%, 30% and 50% concentrations upto 2 hours

The Use of Aloe Vera Extract as a Novel Storage Media for
the Avulsed Tooth

▶ IJMS Vol 39, No 4, July 2014

Propolis:

- ▶ Contents of significance
resin (55%)
essential oils
amino acids, minerals ethanol
vitamins A, B complex, E and bioflavon



Better preservation of root cementum layer

Storage period limit

Upto 45 mins with 90 % viability

The Effect of Propolis As A Biological Storage Media on
Periodontal Ligament Cell Survival in An Avulsed Tooth: An In

▶ Vitro Study

CEI JOURNAL (Yakhteh) Vol 15, No 3, Autumn 2013

Salvia extract:



Contents of significance

- ▶ rosmarinic acid, camosic acid, salvianolic acid
- ▶ antimicrobial, anti-inflammatory and anti-oxidant properties
- ▶ Better cell viability at prolonged storage times

Storage period limit

- ▶ Upto 24 hours with better cell viability than most media

Egg white:

- ▶ Contents of significance

Ovalbumin, proteins ,minerals



- ▶ Absence of contamination and easy access
- ▶ High ph and protein reaction to Pdl cells – risk factor
- ▶ Proved to be better than milk in regeneration

- ▶ Storage period limit

Upto 6-10 hours

Pomegranate juice

▶ Contents of significance

polyphenolic flavonoids

Punicalagin

ellagic acid

Anti oxidant and healing



Storage period limit

6 to a maximum of 24 hours at 7.5%

Pomegranate Juice (*Punica Granatum*): A New Storage Medium for Avulsed Teeth
Journal of Dentistry, Tehran University of Medical Sciences ;March 2014; Vol. 11, No

Tap water

- ▶ Hypotonic and rapid lysis of cells
- ▶ Final choice when no alternative is available
- ▶ Storage period limit
- ▶ Only for a very shorter period of time



A multiparametric assay to compare the cytotoxicity of different storage media for avulsed teeth
Braz J Oral Sci.

▶ April | June 2013 - Volume 12, Number 2

Saliva

- ▶ immediate interim storage medium
- ▶ Buccal vestibule or in a container

Potentially damaging enzymes and bacteria
Reduction in clonogenic capacity

STORAGE PERIOD LIMIT

- ▶ Only for very short extra alveolar periods upto 30 mins

A multiparametric assay to compare the cytotoxicity of different storage media for avulsed teeth

Braz J Oral Sci.

▶ April | June 2013 - Volume 12, Number 2



junior dentist.com

artificial storage media



Hank's Balanced Salt Solution (HBSS):



▶ Contents of significance

sodium chloride, glucose, potassium chloride, sodium bicarbonate, sodium phosphate, calcium chloride, and magnesium chloride and magnesium sulphate

Recommended by AAE

Preserves and reconstitutes Pdl cells

Not easily available

Storage period limit

Extensive – upto 72 to 96 hours with maximum cell viability

Transport media for avulsed teeth: A review

▶ Aust Endod J 2012; 38: 129–136

Autologous serum:

- ▶ maintain the vitality of the PDL during the critical extra-alveolar period.
- ▶ Combination with PRF even better *
- ▶ upto 48 hours with 90% viability



Transport media for avulsed teeth: A review
Aust Endod J 2012; 38: 129–136

*** Use of platelet-rich fibrin as an autologous biologic rejuvenating media for avulsed teeth - an in vitro study.**

[Dent Traumatol.](#) 2014 Dec;30(6):442-6. doi: 10.1111/edt.12119. Epub 2014 Jun 13

Gatorade:

▶ Contents of significance
electrolytes

- ▶ Sports beverage
- ▶ Better than tap water on ice
- ▶ Harmful osmolality
- ▶ Destroys pdl cells



▶ short term storage media upto 20 mins

Transport media for avulsed teeth: A review

▶ Aust Endod J 2012; 38: 129–136

Probiotic solutions

- ▶ Contents of significance
- ▶ Microorganisms (Lactobacillus reuteri)

- ▶ Still under research

Viability of pdl cells is similar to HBSS



Clinical implications of storage media in dentistry
ENDO (Lond Engl) 2010;4(3):179–188

Contact lens solution:

- ▶ essentially saline solutions
- ▶ Osmolarity is damaging to Pdl
- ▶ Cannot be preferred



Viability of Human Periodontal Ligament Fibroblasts in Tissue Culture
After Exposure to Different Contact Lens Solutions

The Journal of Contemporary Dental Practice, Volume 7, No. 4, September 1, 2006



normal saline

- ▶ Similar osmolality
- ▶ No growth products
- ▶ Unable to maintain metabolism of fibroblasts



Storage period limit

- ▶ Upto 30 mins with 80% cell viability

Clinical implications of storage media in dentistry
▶ ENDO (Lond Engl) 2010;4(3):179–188

Cryoprotective agents

- ▶ 5% and 10% dimethyl sulphoxide(DSMO)
- ▶ 10% glycerol

- ▶ Prolonge life time of PDL cell
- ▶ Temperature range of -196°C



Transport media for avulsed teeth: A review

▶ Aust Endod J 2012; 38: 129–136

Rehydrating salts



ORS

- ▶ sodium ,glucose , potassium , chloride , and base (citrate)
- ▶ hypotonic solution
- ▶ Possibility of pH alteration
- ▶ Optimization is needed
- ▶ Viability less than HBSS upto 2 hrs



Ricetral

- ▶ essential nutrients like glucose and vital salts
- ▶ PDL cell viability Similar to HBSS

Special Culture media



MEM cell culture medium: **minimum essential medium**

- ▶ L-glutamin, penicillin, streptomycin, Nistatin, bovine serum and nutrients
- ▶ efficacy in preserving the viability of PDL cells



▶ Storage media for avulsed tooth a review

Indian Journal of Multidisciplinary Dentistry, Vol. 3, Issue 3,

Conditioned medium:

- ▶ supernatant of human gingival fibroblasts
- ▶ stimulatory factors
- ▶ stimulatory effect on the remaining cells on root
- ▶ Low healing rates than viaspan and HBS[®]
- ▶ Not available for public



▶ Storage media for avulsed tooth a review

Indian Journal of Multidisciplinary Dentistry, Vol. 3, Issue 3,

Eagle's medium (EM):

- ▶ Contents of significance
- ▶ amino acids, vitamins and bicarbonates
- ▶ Pdl cells proliferated
- ▶ Not practical
- ▶ Even transfer from saliva produced best results



- ▶ Storage period limit

Upto 60 mins after transferring from primary media with 90% viability

▶ Storage media for avulsed tooth a review

Indian Journal of Multidisciplinary Dentistry, Vol. 3, Issue 3,

Dubelco's storage medium:

- ▶ 4 times vitamins and amino acids present in the regular EM formulation and 2–4 times as much glucose.
- ▶ iron and phenol red
- ▶ Compatible with all types of cells



Organ storage fluids



Custodiol

- ▶ histidine-tryptophan ketoglutarate



- ▶ Similar to ECF
- ▶ organ transplantation
- ▶ inactivating organ function
- ▶ Better tolerance to deoxygenated conditions

- ▶ Comparable to HBSS in all aspects

A multiparametric assay to compare the cytotoxicity of different storage media for avulsed teeth

Braz J Oral Sci.

ViaSpan:

- ▶ Sodium and potassium – same as ICF
- ▶ Unalters cell viability
- ▶ optimal pressure for growth
- ▶ Longterm superiority over HBSS
- ▶ No significant changes in short term storage



A multiparametric assay to compare the cytotoxicity of different storage media for avulsed teeth

Braz J Oral Sci.

Euro- Collins:

- ▶ electrolytes and phosphate buffer to control cell acidosis
- ▶ potassium decreases the intracellular cation loss
- ▶ a low concentration of sodium and chlorine, which avoids cell edema



- ▶ minimize damages to PDL cells
- ▶ provide conditions for cell proliferation

A multiparametric assay to compare the cytotoxicity of different storage media for avulsed teeth

Braz J Oral Sci.

Additives



Emdogain

- ▶ Enamel matrix proteins
- ▶ diminishes the percentage of fibroblasts of the periodontal ligament with capability of forming colonies
- ▶ Delays replacement resorption
- ▶ Alone is not sufficient



▶ Clinical implications of storage media in dentistry
ENDO (Lond Engl) 2010;4(3):179–188

Catalase supplementation

- ▶ Anti oxidant
- ▶ Antagonistic to hydrogen peroxide
- ▶ significant reduction of surface resorption



▶ Storage media for avulsed tooth a review

Indian Journal of Multidisciplinary Dentistry, Vol. 3, Issue 3,

Ascorbic acid

- ▶ increased the ALP activity
- ▶ required for the binding of PDL cells to type I collagen
- ▶ **Type 1 collagen is critical** to pdl differentiation

Growth factors

- ▶ platelet-derived growth factor- (PDGF-) and insulin-like growth factor (IGF)
- ▶ Enhance PDL formation 5 to 10 fold during the early phase of wound healing
- ▶ Mitogenicity upto 37%



- ▶ Supplementation for long time periods (48 hours)

Clinical implications of storage media in dentistry

▶ ENDO (Lond Engl) 2010;4(3):179–188

L - dopa

- ▶ dopaminergic systems
- ▶ Growth promoting hormone like substance

- ▶ Synergistic effects with HBSS
- ▶ Increases mitogenicity



Addition of L-dopa to HBSS in enhancing the maintenance of cell viability of Periodontal Ligament (PDL) cells: an in-vitro study

Journal of Clinical and Diagnostic Research. 2014 Oct, Vol-8(10): ZC79-ZC80

Ready-made kits



Tooth rescue box (Dentosafe):

Contents of significance

- ▶ salts, amino acids, glucose and vitamin
- ▶ Enhanced physiologic function of cells
- ▶ Recommended in first aid kits
- ▶ Not available in all countries



Storage period limit

- ▶ Maintains 90% vitality upto 48 hors

Storage media for avulsed tooth a review

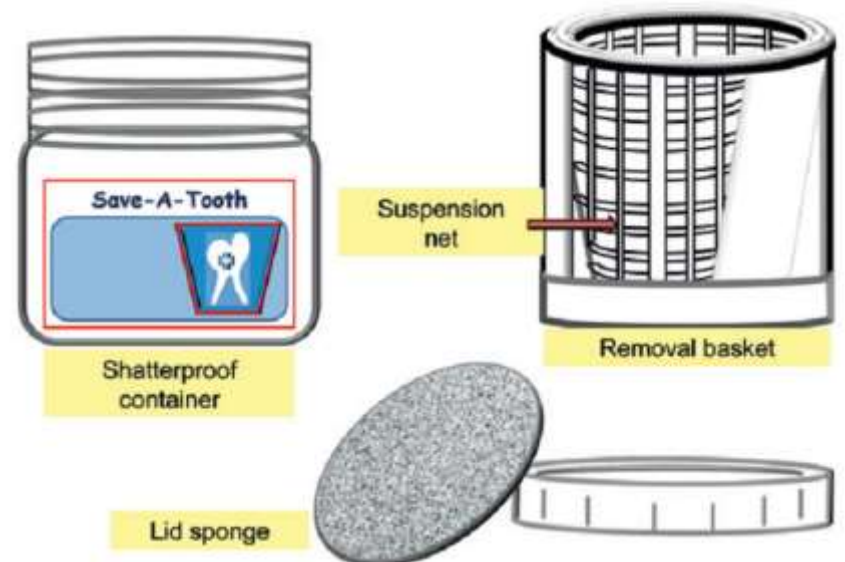
Indian Journal of Multidisciplinary Dentistry, Vol. 3, Issue 3,

Save A tooth

- ▶ Essentially HBSS
- ▶ Recommended by AAE



Not available in india



A multiparametric assay to compare the cytotoxicity of different storage media for avulsed teeth

- ▶ Braz J Oral Sci.
April | June 2013 - Volume 12, Number 2

Order of efficacy

**EAGLE'S CULTURE MEDIUM = VIASPAN = EURO
COLLINS=CUSTODIOL = HBSS \geq COCONUT WATER >
MILK \geq PROPOLIS \geq GREEN TEA \geq EGG \geq RICETRAL**

Extra-Alveolar Storage Media for teeth: A Literature review.
International Journal of Advanced Research (2014), Volume 2, Issue 7,
963-972



So which is best



**AND THE AWARD
GOES TO.....**

VIA ~~X~~ CAN

EAGLE'S
CULTURE
MEDIUM ~~X~~

Milk &
coconut
water

EMBROU
CULTURE ~~X~~

~~X~~

CUSTOM ~~X~~ MOL

Efficacy	Ease of access	Storage medium
Excellent	++	
Excellent	+	Milk , coconut water
Excellent	-	Propolis ,Green tea
Excellent	--	Viaspan,HBSS,Euro collins,MEM
Good	++	
Good	+	Egg white , ricetral/ORS
Good	-	Red mulberry
Good	--	
Poor	++	
Poor	+	Saline,gatorade,contact lens solution
Poor	-	
Poor	--	
Very poor	++	Water , saliva
Very poor	+	
Very poor	-	
Very poor	--	

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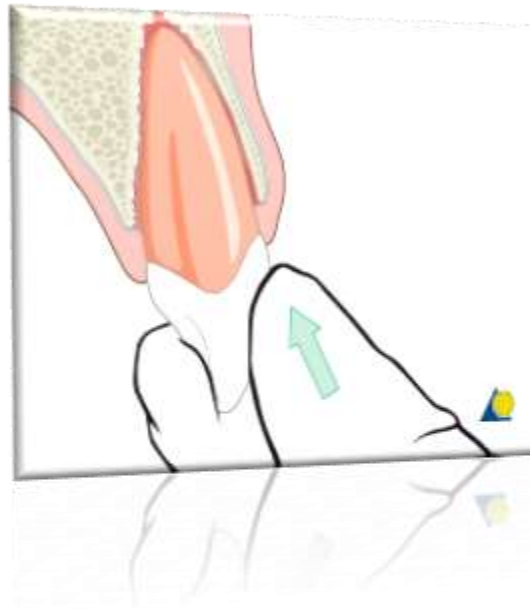
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Poor	++	
Poor	+	Saline,gatorade,contact lens solution
Poor	-	
Poor	--	
Very poor	++	Water , saliva
Very poor	+	
Very poor	-	
Very poor	--	

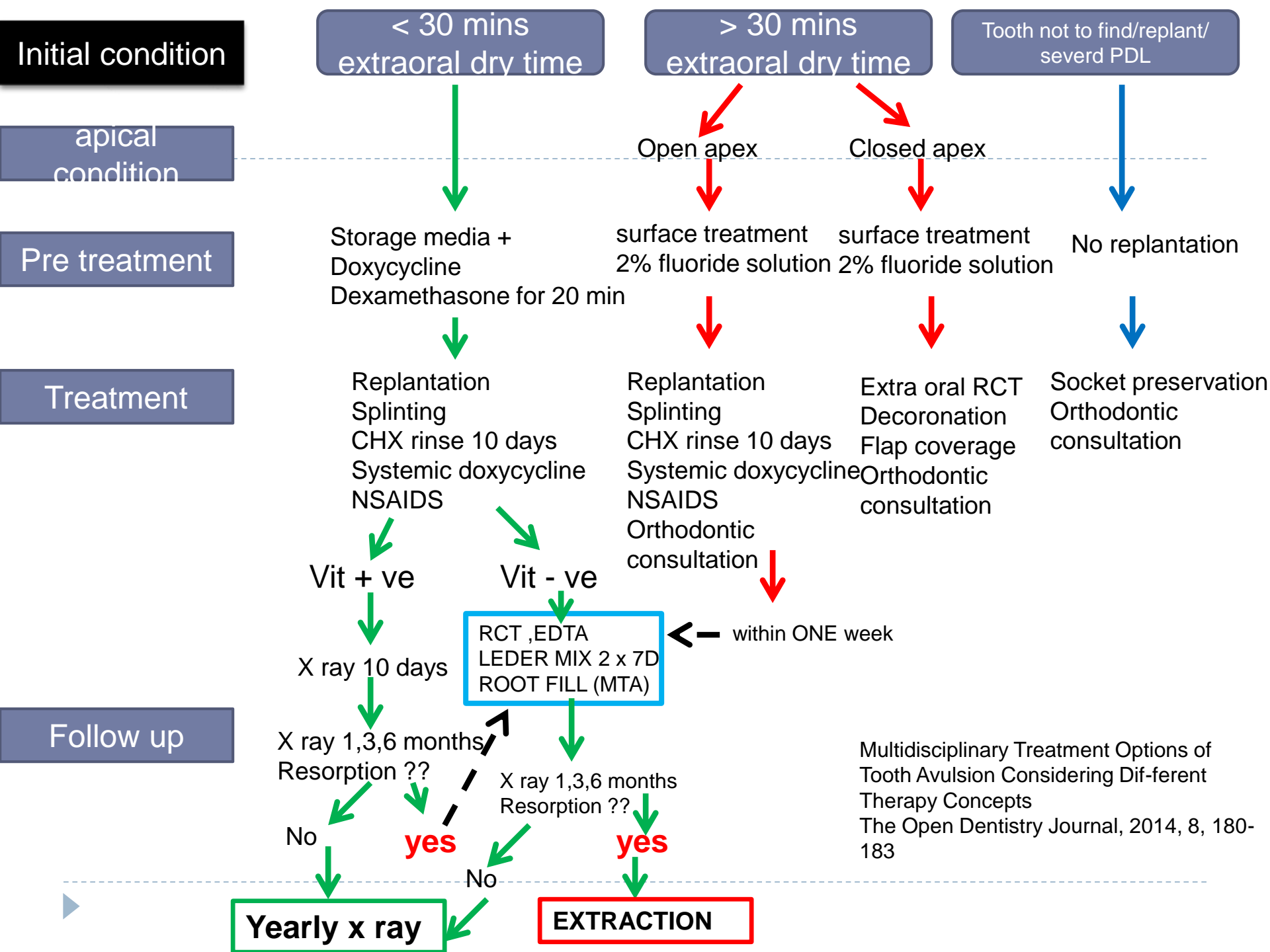
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Poor	--	
Very poor	++	Water , saliva
Very poor	+	
Very poor	-	
Very poor	--	

Replantation

- ▶ **Replantation** is the insertion of a tooth in its socket after its complete avulsion resulting from traumatic injury





Intra canal medicaments

- ▶ Importance – promote PDL healing.
- ▶ Topical medicaments were used
- ▶ Disadvantage – poor retention & wash out
- ▶ Placed in the canal

P. F. DAY & T. A. GREGG. Treatment of avulsed permanent teeth in

▶ Children.

UK National Clinical Guidelines in Paediatric Dentistry

-
- ▶ Bacteria present in the pulp & dentinal tubules – mainly lead to inflammatory resorption.
 - ▶ To kill this bacteria – ICM are used
 - ▶ Eliminates the resorbing cells of root surface

P. F. DAY & T. A. GREGG. Treatment of avulsed permanent teeth in

▶ Children.

UK National Clinical Guidelines in Paediatric Dentistry

Commonly used

- ▶ Non – setting Calcium hydroxide (Ultracal XS)
- ▶ Ledermix – 1% triamcinolone + 3% demeclocycline
- ▶ Triamcinolone
- ▶ Democlocycline
- ▶ Calcitonin paste
- ▶ Bisphosphonate (etidronate disodium)

Non – setting Calcium hydroxide:

- ▶ Prevents inflammatory resorption, lesser extent of ankylosis

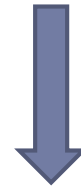
Eckehard Kostka. Multidisciplinary
Treatment Options of Tooth Avulsion
Considering Different Therapy Concepts.

***The Open Dentistry Journal, 2014, 8,
180-183***

▶ Ledermix – 1% triamcinolone + 3% demeclocycline



dampen inflammatory
response



discoloration

Eckehard Kostka. Multidisciplinary
Treatment Options of Tooth Avulsion
Considering Different Therapy Concepts.

▶ ***The Open Dentistry Journal, 2014, 8,
180-183***

Recommendations for use of ICM

- ▶ Observation period of luxated matured teeth – 1 year
– CaOH – commonly used
- ▶ Avulsion of mature teeth, pulp necrosis is inevitable.
- ▶ ICM – to promote PDL repair.



Time period

- ▶ RCT – done **within** 7 – 10 days of replantation
Ca(OH)₂ – upto one month
- ▶ RCT – done **after** 7-10 days of replantation
Ca(OH)₂ – 6 to 24 months
(until healing of resorption occurs)

Andresen. International association of dental traumatology guidelines for management of traumatic dental injuries: 2. avulsion of permanent teeth. Dental traumatology, 2012; 28: 88-96.

Splinting

- ▶ For temporary support & immobilization
- ▶ Commonly used are flexible splints or semi – rigid devices

Kahler. An evidence-based appraisal of splinting luxated, avulsed and root-fractured teeth. *Dental Traumatology* 2008; 24: 2–10.



Wire composite splint



Ortho wire splinting



Button bracket splint



Resin splint





cap splint



Titanium trauma splint



-
- ▶ Open apex or closed apex
immediately replanted or **< 30 min.** – flexible splints 1-
2wks

 - ▶ Open apex or closed apex
> 30 min – flexible splints 4 – 6 wks.

Andresen. International association of dental traumatology guidelines for management of traumatic dental injuries: 2. avulsion of permanent teeth. Dental traumatology,2012;28:88-96.

-
- ▶ The types of splints and splinting duration no significant effect on healing outcome
 - ▶ cap splints and orthodontic bands – more pulp necrosis and obliteration

Kahler. An evidence-based appraisal of splinting luxated, avulsed and root-fractured teeth
Dental Traumatology 2008; 24: 2–10.



Potential aspects

- ▶ Capacity to maintain viability is important than extra oral time *
- ▶ Many storage media upto 90 % viability for longer periods
- ▶ Further investigation needed in vivo
- ▶ modification in treatment protocol ??



* Comparative evaluation of maintenance of cell viability of an experimental transport media “coconut water” with Hank’s balanced salt solution and milk, for transportation of an avulsed tooth: an in vitro cell culture study.

Conclusion

- ▶ Appropriate media – good prognosis
- ▶ Awareness
- ▶ Readymade kits should be made available
- ▶ Act in time – can save a tooth *



* Tooth Avulsion- A Dental Emergency

INDIAN JOURNAL OF APPLIED RESEARCH Volume : 3 | Issue : 11 | Nov 2013



Arigato

Mahalo

Grazie

Spasiba

THANK
YOU

Thinks
Moite

Gracias

Merci

Danke

Shukran