

Association of Dental Pulp Stone with Cardiovascular, Kidney Stones and Diabetic Mellitus: A Systemic Review

Mohammed Abdulmohsen Alyousif¹, Jana Mohammed Al Rumayh², Amal Jamaan Alharbi³, Mona Saad Alharbi⁴, Rana Ahmed Aloraini⁵, Abdullah Majed Alhojailan⁶, Mohammad Qahtan Alfahhad⁷, Ahmed El Kabbaney⁸

Abstract:

Background: Pulp stone are nodular dystrophic calcifications that shows conflict association to many medical conditions in the literature such as cardio vascular diseases, kidney stone and diabetes mellitus. This systemic review aimed to identify the presence of association of dental pulp stone to diabetes mellitus, cardio vascular diseases, and renal stone.

Methods: Data bases were searched from 2010 to 2021 using the Cochrane methodology and reported findings according to PRISMA. CINAHL, Cochrane Library, Medline and PubMed. After removal of duplication, 46 studies were found and reviewed. 3 variables were used for statistical analysis (year of publishing, medical condition studies, type of association) and the correlation has been statistically studied by SPSS.

Results: The majority of reviewed articles (52.2%) were concerning on pulp stone in association with cardio vascular diseases followed by diabetes mellitus (23.9%) and renal stone (10.9%). (78%) of all studies found that there is positive association. The result showed that most of recent (80.0%) and older (76.2%) studies admit the presence of relation to cardio vascular diseases (79.2%), renal stone (60.0%) and diabetes mellitus.

Conclusions: From the present study, we can conclude that pulp stone was prevalent in cardio vascular diseases and diabetes mellitus population as well as renal stone patients. The cardio vascular group have the highest prevalence of pulp stone followed by diabetic group and less prevalence in renal stone patients. This might suggest a possibility of altered pathogenesis that require further assessment or management for these patients.

Introduction:

Pulp stones are dystrophic calcifications that appear as nodular masses in the pulp chamber of the tooth. Clinically, these stones usually painless and identified radiologically as round or ovoid radiopaque stones with varying sizes in a single tooth (**Berèsetal. 2016**). Numerous studies were conducted to emphasize the relation between pulp stone and dental health such as pulpal irritations, dental caries, periodontal diseases as well as age and gender (**Sisman et al., 2012**) (**Baghdady et al., 1988**). In many instances, there is no definitive etiology behind the pathogenesis of this degenerative calcifications (**Ramesh et al., 2018**). There is a conflict in the association between pulp stone and health or disease status of individuals such as atheromatous plaques in the vessel, renal stones and diabetes mellitus.

In a study conducted by (**Bains et al, 2014**) (**Movahhedian et al, 2018**) on cases with nephrolithiasis who present with hematuria, dysuria, renal colic and abdominal pain, and under went dental panoramic examination, showed no correlation between the presence of dental pulp and kidney stone though **Bainsetal** concluded that pulp stone cases have high propensity to develop cardio vascular disease. On the other hand (**Sayegh & Reed, 1968**) concluded that cardio vascular diseases and renal stone scan be considered as a predisposing factor to pulpal calcification which was later confirmed (**Eddsetal. 2005**). (**Jawahar et al, 2021**) studied the histological association of pulp stones with hyperlipidemia and systemic hypertension. The author recommended to evaluate lipid profile and blood pressure measurement to individuals who have irregular-shaped pulp stone.

Dental pulp cells produce osteopontin (OPN) and its expression is important information of pathologic pulp calcifications. (**Inagaki et al, 2010**) conducted an experimental study on cultured rat dental pulp cells and studies the effect of hyperglycemia on OPN production in diabetic rats compared with healthy one.

There search showed that a high concentration of glucose increases OPN protein production and alkaline phosphatase activity and plays an important role in the pathogenesis of dental dystrophic calcification. In addition, hyperglycemia is associated with changes in the morphology of the normal dental pulp due to less vascular blood flow showed evidenced histologically by thickened blood vessel walls, and more collagen deposition and crystallization (Alsamahi et al, 2022).

There are many proposed theories regarding the association of pulpal calcification to number of conditions stone. This systematic review aimed to identify the presence or absence of association between pulp stone and cardiovascular, diabetes mellitus and renal stone.

Objectives:-To identify the presence of association of dental pulp stone to diabetes mellitus, cardio vascular diseases, and renal stone.

Methodology:

Data bases were searched from 2010 to 2021 using the Cochrane methodology and reported findings according to PRISMA. CINAHL, Cochrane Library, Medline and PubMed. The search was limited to pulp stone association to cardiovascular diseases, renal stones and diabetes mellites and after removal of duplication, 46 studies were found and reviewed. Titles, author, year of publishing and conclusion were plotted in a table (table-1) which is refined to 3 variables for statistical analysis (year of publishing, medical condition studies, type of association) and submitted in (table-2). The correlation has been statistically studied by SPSS.

Flowchart:-Databases – date were refined to – duplication –variables to be study were- conclusions of articles were- Statistical analysis by.

Results:

A total of 46 articles reviewed. The majority of reviewed articles (52.2%) were concerning on pulps one in association with cardio vascular diseases including atheromatous and ischemic heart disease. The articles that concerned about the association of pulp stone with renal stone and diabetes mellitus (10.9% and 23.9% respectively). Few studies were conducted on the association with general heath including combination of all medical parameters.

Table-3: Medical Conditions Reviewed

	Frequency	Percent
Cardiovascular	24	52.2
Renal Stone	5	10.9
Diabetes Mellitus	11	23.9
All heath conditions	2	4.3
Cardio vascular and Diabetes Mellitus	2	4.3
Cardio vascular and Renal Stone	2	4.3
Total	46	100.0

In general, 78% of all studies found that there is positive association and while 21% concluded that there is no association (Figure-1)

Table 4: Types of Association

	Frequency	Percent
Positive Association	36	78.3
Negative Association	10	21.7
Total	46	100.0

Table-5: Cross tab: Study years vs. type of association.

			year of study		Total
			2010 - 2016	2017 - 2022	
Type of Association	positive association	Count	16	20	36
		% within association	44.4%	55.6%	100.0%
		% within year of study	76.2%	80.0%	78.3%
		% of Total	34.8%	43.5%	78.3%
	negative association	Count	5	5	10
		% within association	50.0%	50.0%	100.0%
		% within year of study	23.8%	20.0%	21.7%
		% of Total	10.9%	10.9%	21.7%
Total	Count	21	25	46	
	% within association	45.7%	54.3%	100.0%	
	% within year of study	100.0%	100.0%	100.0%	
	% of Total	45.7%	54.3%	100.0%	

Both recent and old studies admitted the relation between the association between pulp stone and medical condition but 80% of recent published data admit the strong relation between these two conditions. On the other hand, only 20% of studies rejected the possible relation between them.

Table-6: Cross tabulation: Type of association vs medical condition studied.

association		medical condition studied						Total
		Cardiovascular	Renal Stone	Diabetes Mellitus	All	Cardiovascular and Diabetes Mellitus	Cardiovascular and Renal Stone	
positive association	Count	19	3	9	2	2	1	36
	% within association	52.8%	8.3%	25.0%	5.6%	5.6%	2.8%	100.0%
	% within medical condition studied	79.2%	60.0%	81.8%	100.0%	100.0%	50.0%	78.3%

The majority of cardiovascular diseases studies that showed strong relationship with pulp stone 79.2%. These studies recommended blood pressure and cardio vascular examination to excluded is chemical changes in people who have stone pulp.

Discussion:

The pulp stones are asymptomatic incidental finding in healthy and diseased individuals. The prevalence of pulp stone reported with various medical conditions is studied radiologically (Kannan et al., 2015) and histologically (Huang et al, 2016) Considering the association between pulp stone to many factors, such as age, gender and dental health has been approved by many studies (Udoyeetal, 2011).The argument in the literature was about the association of this dental condition to the systemic medical conditions. Our study was concerned on reviewing articles that are conducted to assess whether dental pulp stone is related cardio vascular diseases, diabetes mellites and renal stone. The result showed that most of recent (80.0%) and older (76.2%) studies admit the strong relation to cardio vascular diseases (79.2%), renal stone (60.0%) and diabetes mellites (81.8%). Based on the conclusions of these studies multiple factors were explained. Endothelial alteration by hyper glycemics tateora there sclerotic changes were the explanation for several studies (Takashima et al, 2023) and (Jawahar, et al 2021). Some studies considered pulp stone as an initial risk factor for cardio vascular disease (S, N. et al 2021) and recommended cardio vascular assessment and blood sugar measurements. However, (Gunen et al. 2019) reported hypertension as a non- risk factor for the pulp stone. With the fact that pulp stone is a dystrophic calcification, 40.0% of articles rejected the association between renal stone genesis due to hyper calcemia and pulp stone formation. Metastatic calcification seen in various organs such as kidney, joints and teeth are primarily made up of calcium.

phosphate crystals.These crystals deposit is tissue if concomitant ischemic heart disease event has occurred (Loya. and Nikhade, 2021). This may explain our higher result, (100%) of studies, concerning combined cardiovascular and renal stone which showed positive association.

Thus, based on the results of reviewed study, there is a solid ground association between systemic diseases, such as cardio vascular diseases and diabetes mellitus with pulp stone and they can be considered as the risk factors. Regarding renal stone, there is a relative relation but more studies in this field must be conducted. This enforces there commendation of screening of such dental patients to evaluate their medical status clinically and implement early intervention stomanage their medical conditions before they develop any complications.

Conclusion

From the present study, we can conclude that pulp stone was prevalent in cardio vascular diseases and diabetes mellitus population as well as renal stone patients.The cardio vascular group have the highest prevalence of pulp stone followed by diabetic group and less prevalence in renal stone patients.This might suggest a possibility of altered pathogenesis that require further assessment or management for these patients.

References

- Almutlaq, maha & mathew, shibu & al-aidan, razan & alkhraisi, danah. (2019). Prevalence of pulp stones and its relation with cardio vascular diseases and diabetes mellitus using digital radiographs: aretrospective study.<https://www.researchgate.net/publication/339297902> prevalence of pulp stones and its relation with cardiovascular diseases and diabetes mellitus using digital radiographs a retrospective study.
- Alsamahi, S. A. S. M. (2020). Type 2 diabetes and the dental pulp (Thesis, Doctor of Philosophy).University of Otago. Retrieved from <http://hdl.handle.net/10523/10588>
- Alsamahi, S., Milne, T. M., Hussaini, H., Rich, A. M., & Friedlander, L. T. (2022).Type 2 diabetes and the clinically normal pulp: An in vitro study. *International endodontic journal*, 55(6),660–671.<https://doi.org/10.1111/iej.13732>
- Alsweed, A., Farah, R., Ps, S., & Farah, R. (2019). The Prevalence and Correlation of Carotid Artery Calcifications and Dental Pulp Stones in a Saudi Arabian Population. *Diseases (Basel, Switzerland)*, 7(3), 50.<https://doi.org/10.3390/diseases7030050>
- Araya P,Vega- Marcich M,OlivaresK,et al.(2020). Pulp calcifications in patients with diabetes mellitus. *Rev Cubana Estomat ol.*; 57(1).<https://www.medigraphic.com/cgi-bin/new/resumenI.cgi?IDARTICULO=97149>
- Asghari, M., Nasoohi, N., &Hodjat, M. (2021). High glucose promotes the aging of human dental pulp cells through Wnt/beta-catenin signaling. *Dental and medical problems*, 58(1),39–46. <https://doi.org/10.17219/dmp/130090>.
- Babu, S. J., Swar nalatha, C., Rao, A. P., Kumar, B. B., Tilak, B. P., Naidu, R. B., & Nayyar, A.S.(2020).Pulp Stones as Risk Predictors for Coronary Artery Disease. *International journal of preventive medicine*.
- Baghdady, V. S., Ghose, L. J., &Nahoom, H. Y. (1988). Prevalence of pulp stones in a teenage Iraqi group.*Journal of endodontics*, 14(6), 309–311. [https://doi.org/10.1016/S0099-2399\(88\)80032-3](https://doi.org/10.1016/S0099-2399(88)80032-3)

https://doi.org/10.4103/ijpvm.IJPVM_68_19.

- Bains, a., & bains,s.(2015).pulp stones'association with renal stones:"a minute one can help detecta large one". *Annals of tropical medicine and public health*, 8(1), 19.<https://link.gale.com/apps/doc/a413980381/hrca?u=google scholar & sid=book mark-hrca & sid=10e636a7>
- Bains, S. K., Bhatia, A., Singh, H. P., Biswal, S. S., Kanth, S., &Nalla, S. (2014). Prevalence of coronal pulp stones and its relation with systemic disorders in northern Indian central punjabi population. *ISRNdentistry*, 2014,617590. <https://doi.org/10.1155/2014/617590>.
- Berès, F., Isaac, J., Mouton, L., Rouzière, S., Berdal, A., Simon, S., & Dessombz, A.(2016).Comparative Physico chemical Analysis of Pulp Stone and Dentin. *Journal of endodontics*, 42(3),432–438. <https://doi.org/10.1016/j.joen.2015.11.007>.
- Dissanayaka, W. L., Zhan, X., Zhang, C., Hargreaves, K. M., Jin, L., & Tong, E. H.(2012). Coculture of dental pulp stem cells with endothelial cells enhances osteo-/odontogenic and angiogenic potential in vitro. *Journal of endodontics*, 38(4),454–463.<https://doi.org/10.1016/j.joen.2011.12.024>
- Edds, A.C.,Walden, J.E., Scheetz, J.P., Goldsmith, L.J., Drisko, C.L.,& Eleazer, P.D. (2005). Pilot study of correlation of pulp stones with cardio vascular disease. *Journal of endodontics*, 31(7),504–506.<https://doi.org/>.
- Ezoddini-ardakani, f.,namayandeh., mohammadiz.,shahrabi-farahani,s.,hedayati,a.s.,&rahmani-baghemalek, m. j. (2011). association of pulp stones with coronary artery stenosis .*communitydental health*,28(4),305–307<https://pubmed.ncbi.nlm.nih.gov/22320071/0.1097/01.don.0000168890.42903.2b>.
- Ezoddini-ardakani, fatemeh & namayandeh, seyedehmahdieh & sadrbafghi, seyed & hajihashemi, sedigheh & emami, mahmood & kahtouei, for ouzandeh & hadiani, leila & ahmadieh, mohammad & moeini, maliheh & razavi, seyed & besharati, sajad. (2015). diagnostic value of dental pulp stones in the early diagnosis of ischemic heart diseases. *health*.7.336-345.10.4236/health.2015.73038.
- Galav, ashok & vyas,tarun & kaur, manpreet & chauhan, manasi & satija, nupur.(2018). Association of pulp stones and renal stones-a clinical study. https://www.researchgate.net/publication/325169324_association_of_pulp_stones_renal_stones_a_clinical_study.
- GonzalezMarrero,Y.,Kobayashi,Y.,Ihsan,M.S.,Pilch,L.A.,Chen,L.,Jiang,S.,Ye,Y.,Fine,D.H.Falcon,C.Y.,Falcon,P.A., Hirschberg,C.S.,& Shimizu, E. (2022). Altered Prevalence of Pulp Diagnoses in Diabetes Mellitus Patients: A retrospective Study. *Journal of endodontics*, 48(2), 208–212.e3. <https://doi.org/10.1016/j.joen.2021.11.001>.
- Gunen Yilmaz,S.,Yilmaz,F.,Bayrakdar,I.S.,&Harorli,A.(2019).The Relationship between carotid artery calcification and pulp stone among hemodialysis patients: A retrospective study. *Saudi journal of kidney diseases and transplantation : an official publication of the Saudi Center for Organ Transplantation,SaudiArabia*, 30(4),755–763.<https://doi.org/10.4103/1319-2442.265449>.
- Hoshyari N, Farahbod F, Nabati M, Haddadi A, Mousavi J, Shahsavari N. Association between Coronary Artery Sclerosis and Dental Pulp Calcification in Patients Attending Sari Touba Clinic, 2019. *Jmazandaran Univ Med Sci*2022;31(204):157-164URL:<http://jmums.mazums.ac.ir/article-1-16670-en.html>.
- Huang, L. G., & Chen, G. (2016). A histological and radiographic study of pulpal calcification in periodontally involved teeth in a Taiwanese population. *Journal of dental sciences*,11(4),405–410.<https://doi.org/10.1016/j.jds.2016.05.001>.
- Inagaki,Y.,Yoshida,K.,Ohba,H.,Seto,H.,Kido,J.,Haneji,T.,&Nagata,T.(2010).High glucose levels increase osteopontin production and pathologic calcification in rat dental pulp tissues. *Journal of endodontics*, 36(6),1014–1020.<https://doi.org/10.1016/j.joen.2010.03.018>.
- Jawahar, G., Rao, G. N., Vennila, A. A., Fathima, S. D., Lawanya, M. K. K., Doss, D.M.,Sherwood,I.A.,Antinisha, A.A.,&Bhuvana,B.(2021).Clinico pathological Correlation of Pulp Stones and Its Association with Hypertension and Hyperlipidemia: An Hospital-based Prevalence Study. *Journal of pharmacy & bioallied sciences*, 13(Suppl2), S1268–S1274.https://doi.org/10.4103/jpbs.jpbs_475_21.
- Kannan, S., Kannepady, S. K., Muthu, K., Jeevan, M. B., &Thapasum, A. (2015). Radiographic assessment of the prevalence of pulp stones in Malaysians. *Journal of endodontics*,41(3),333–337.<https://doi.org/10.1016/j.joen.2014.10.015>
- Khojastepour,L.,Bronoosh,P.,Khosropanah,S.,&Rahimi,E.(2013).Candental pulp calcification predict the risk of ischemic cardio vascular disease?. *Journal ofdentistry (Tehran, Iran)*,10(5),456–460.<https://pubmed.ncbi.nlm.nih.gov/24910654/>.
- Krishna KanthJaju, Raghu Sandhya, KrithikaDatta. (2021). Prevalence Of Pulpal Calcification In Patients With Hypertension-A Retrospective Study.*International Journal of Dentistry and Oral Science (IJDOS)*. ISSN: 2377-8075.https://www.academia.edu/en/59013920/Prevalence_Of_Pulpal_Calcification_In_PatientsWith_Hypertension_A_Retrospective_Study.

- Loya, P. and Nikhade, P. (2021) "Evaluation and Correlation of Pulpal Calcification in the Patients with Cardiovascular Diseases in Vidarbha Region, India", *Journal of Pharmaceutical Research International*, 33(63B), pp.249–253. <https://doi.org/10.9734/jpri/2021/v33i63B35283>.
- Ma, X., Wang, Y., Liu, Q., Han, B., Wang, G., Zhang, R., Huang, X., Wang, X., Yang, M., Xing, C., Hou, J., & Yu, B. (2022). Vaspinnal eviates the lnc RNALEF1-AS1-induced osteogenic differentiation of vascular smooth muscle cells via the Hippo/YAP signaling pathway. *Experimental cell research*, 421(2), 113407. <https://doi.org/10.1016/j.yexcr.2022.113407>.
- Moraru, A. I., Gheorghii Ță, L. M., Dascălu, I. T., Bătăiosu, M., Manolea, H. O., Agop Fornă, D., Răcă, A. M., RaȚiu, C. A., & Diaconu, O. A. (2017). Histological and immunohistochemical study on the dental pulp of patients with diabetes mellitus. *Romanian journal of morphology and embryology=Revue roumaine d'embryologie et embryologie*, 58(2), 493–499.
- Movahhedian, N., Haghnegahdar, A., & Owji, F. (2018). How the Prevalence of Pulp Stone in a Population Predicts the Risk for Kidney Stone. *Iranian endodontic journal*, 13(2), 246–250. <https://doi.org/10.22037/iej.v13i2.18181>.
- Nakajima, Y., Inagaki, Y., Hiroshima, Y., Kido, J., & Nagata, T. (2013). Advanced glycation end-products enhance calcification in cultured rat dental pulp cells. *Journal of endodontics*, 39(7), 873–878. <https://doi.org/10.1016/j.joen.2012.11.027>.
- Nayak, M., Kumar, J., & Prasad, L. K. (2010). A radiographic correlation between systemic disorders and pulp stones. *Indian journal of dental research, official publication of Indian Society for Dental Research*, 21(3), 369–373. <https://doi.org/10.4103/0970-9290.70806>.
- Nicklisch, N., Schierz, O., Enzmann, F., Knipper, C., Held, P., Vach, W., Dresely, V., Meller, H., Friederich, S., & Alt, K. W. (2021). Dental pulp calcifications in prehistoric and historical skeletal remains. *Annals of anatomy Anatomischer Anzeiger: official organ of the Anatomische Gesellschaft*, 235, 151675. <https://doi.org/10.1016/j.aanat.2021.151675>.
- Nitish B, Rubeena A, Rakesh G & Kalpna T. (2022) Oral and Cardiovascular Health: An Unascertained Connection. *Journal of Cardiovascular Disease Research*, 12(6):1038-1044. <https://www.researchgate.net/publication/363485485> Oral and Cardiovascular Health: An Unascertained Connection.
- Panwar Pratyaksha S, Debkant J, Chowdary Nagarjuna G, Dwijendra K S, Kumar S Pradyumna, Kumar S Manoj, Nayyar Abhishek S (2019). Pulp stones as risk predictors for coronary artery disease: An intriguing prevalence study. *Research in Cardiovascular Medicine* Volume: 8 Issue Number: 2 | Page: 54-58.
- Patil S. R. (2015). Prevalence of and relationship between pulp and renal stones: A radiographic study. *Journal of oral biology and craniofacial research*, 5(3), 189–192. <https://doi.org/10.1016/j.jobcr.2015.06.010>
- Patil, S., & Sinha, N. (2013). Pulp Stone, Haemodialysis, End-stage Renal Disease, Carotid Atherosclerosis. *Journal of clinical and diagnostic research: JCDR*, 7(6), 1228–1231. <https://doi.org/10.7860/JCDR/2013/5087.3042>.
- Pettiette, M. T., Zhong, S., Moretti, A. J., & Khan, A. A. (2013). Potential correlation between statins and pulp chamber calcification. *Journal of endodontics*, 39(9), 1119–1123. <https://doi.org/10.1016/j.joen.2013.06.005>.
- Puşcaşu, Cristina Gabriela, Corina Laura Ştefănescu, Rodica Maria Murineanu, Mircea Grigorian, Lucian Cristian Petcu, Elena Dumea, Liliana Sachelarie, and Radu Andrei Puşcaşu. 2021. "Histological Aspects Regarding Dental Pulp of Diabetic Patients" *Applied Sciences* 11, no. 20: 9440. <https://doi.org/10.3390/app11209440>.
- Ramesh, A., Varghese, S., Jayakumar, N. D., & Malaiappan, S. (2018). Comparative estimation of sulfiredoxin levels between chronic periodontitis and healthy patients - A case-control study. *Journal of periodontology*, 89(10), 1241–1248. <https://doi.org/10.1002/JPER.17-0445>.
- S, N., Chandran, A., B, S., S, G., A, M., Muddebihal, F., & Nayyar, A. S. (2021). Pulp Stones: Diagnostic Significance in Early Diagnosis and Radiographic Correlation with Ischemic Heart Diseases. *The Indian journal of radiology & imaging*, 31(2), 277–283. <https://doi.org/10.1055/s-0041-1731829>.
- Satheesh kumar, P. S., Mohan, M. P., Saji, S., Sadanandan, S., & George, G. (2013). Idiopathic dental pulp calcifications in a tertiary care setting in South India. *Journal of conservative dentistry: JCD*, 16(1), 50–55. <https://doi.org/10.4103/0972-0707.105299>.
- Sayegh, F. S., & Reed, A. J. (1968). Calcification in the dental pulp. *Oral surgery, oral medicine, and oral pathology*, 25(6), 873–882. [https://doi.org/10.1016/0030-4220\(68\)90165-5](https://doi.org/10.1016/0030-4220(68)90165-5)
- Sisman, Y., Aktan, A. M., Tarim-Ertas, E., Ciftçi, M. E., & Sekerci, A. E. (2012). The prevalence of pulp stones in a Turkish population. A radiographic survey. *Medicina oral, pathological oral chirurgia bucal*, 17(2), e212–e217. <https://doi.org/10.4317/medoral.17400>
- Sönmez Kaplan, Sema & Kaplan, Tuna & Sezgin, Pelin. (2021). Assessment of the frequency and correlation of carotid artery calcifications and pulp stones with idiopathic osteosclerosis using digital panoramic radiographs. *Clinical and Experimental Health Sciences*.

- Sridevi K, et al. (2019). Pulp Stones as Risk Predictors for Coronary artery disease (CAD). *Ann Med Health Sci Res.*;9:509-513 <https://www.amhsr.org/articles/pulp-stones-as-risk-predictors-for-coronary-artery-disease-cad-5145.html>
- Srivastava, K. C., Shrivastava, D., Nagarajappa, A. K., Khan, Z. A., Alzoubi, I. A., Mousa, M. A., Hamza, M., David, A. P., Al-Johani, K., Sghaireen, M. G., & Alam, M. K. (2020). Assessing the Prevalence and Association of Pulp Stones with Cardio vascular Diseases and Diabetes Mellitus in the Saudi Arabian Population-ACBCT Based Study. *International journal of environmental research and public health*, 17(24),9293. <https://doi.org/10.3390/ijerph17249293>.
- Sugiyama, K., Miura, J., Shimizu, M., Takashima, A., Matsuda, Y., Kayashima, H., Okamoto, M., Nagashima, T., & Araki, T. (2022). Effects of advanced glycation end products on dental pulp calcification. *Oral diseases*, 28(3),745–755. <https://doi.org/10.1111/odi.13792>.
- Swathy, S & Sukumaran, Gheena&Varsha, Sri. (2015). Prevalence of pulp stones in patients with history of cardiac diseases. *Research Journal of Pharmacy and Technology*.8.1625.10.5958/0974-360X.2015.00291.7. <https://rjptonline.org/HTMLPaper.aspx?Journal=Research%20Journal%20of%20Pharmacy%20and%20Technology;PID=2015-8-12-5>.