

COMPARATIVE EVALUATION OF BONE REGENERATION IN EXTRACTION SOCKETS WITH AND WITHOUT APPLICATION OF RESVERATROL - A PROSPECTIVE SPLIT MOUTH STUDY

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ABSTRACT

Aim: To evaluate and compare the effectiveness of locally applied resveratrol on alveolar bone regeneration in extraction sockets versus normal socket healing.

Materials and Methods: Sixteen patients were enrolled in this study. At the study site, 99.99% resveratrol powder mixed with normal saline was incorporated into an absorbable gelatin sponge, placed into the extraction socket, and secured with 3-0 silk sutures. Control sockets underwent routine healing. Clinical and radiographic parameters assessed included postoperative pain, soft tissue healing, facial swelling, salivary alkaline phosphatase (S-ALP) levels, bone mineral density (BMD), and socket size.

Results: Postoperative pain, swelling, and soft tissue healing on Days 1 and 7 were comparable between groups, with no statistically significant differences. Mean S-ALP levels increased significantly from 25.61 ± 4.44 IU on Day 1 to 35.57 ± 4.86 IU on Day 7 ($p < 0.001$), indicating enhanced bone turnover. At 8 weeks, mean BMD was significantly higher in the study group (334.04 ± 124.57 HU) compared to the control group (264.04 ± 128.02 HU) ($p = 0.026$). CBCT analysis demonstrated significantly smaller mean socket size in the study group (28.05 ± 3.49 mm) than in the control group (31.75 ± 4.32 mm) ($p < 0.001$), suggesting greater socket fill and bone regeneration.

Conclusion: Local application of resveratrol promoted hard tissue healing, evidenced by increased S-ALP levels, higher bone mineral density, and reduced socket dimensions compared with normal healing. No significant differences in pain, swelling, or soft tissue healing were observed. Resveratrol appears to be a safe and effective adjunct for enhancing post-extraction socket bone regeneration.

Keywords: Extraction, Socket, Bone regeneration, Resveratrol, Healing

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INTRODUCTION

Alveolar bone degrades naturally to a certain extent without mechanical stimulation, which may complicate the rehabilitation process. (1) The height of the crestal bone reduces within the first 3 months, and the width of the alveolar bone is reduced by about 50% within 1 year after extraction, which may lead to atrophy, affecting the placement of prosthetic dental

implants, leading to esthetic issues as well as instability. (2)

Bone preservation following tooth extraction can be important in preventing the atrophy of the involved hard tissue structures, as well as play an important role in rehabilitation. (3)

Resveratrol is one such material commonly available as dietary nutritional supplements and

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botanical products that shows a wide range of pharmacological benefits. (5) It is an antioxidant commonly administered orally in the form of capsules and supplement powders and is shown to be beneficial for the treatment of osteoporosis, diabetes, arthritis, cardiac disorders, aging disorders, and platelet aggregation. (6)

Bone biomarkers such as alkaline phosphatase enzyme (ALP) have often been associated with bone formation. (9)

When there is increased expression of ALP, it stimulates osteoblast production by increasing osteoblastic proliferation as well as stimulation. Resveratrol is known to be responsible for improved ALP expression as well as inducing Bone Morphogenic Protein (BMP) production. This is based on studies on human periodontal ligament (hPDL) cells and osteoblast-like (MC3T3-E1) cells. (10)

Like the serum, saliva, and Gingival Crevicular Fluid (GCF) are also commonly used body fluids when it comes to diagnostic procedures. The salivary/GCF collection procedure is much easier, noninvasive, painless, and can be collected multiple times. ALP plays a crucial role in the formation of hard tissue, being expressed in high concentration in mineralized tissue cells. (11)

These effects of resveratrol make it an ideal biochemical material which promotes alveolar bone formation in the extraction socket rather than the usual sequelae stage into bone resorption leading to deformity in the alveolar ridge.

Thus, this study investigates the management of extraction sockets using resveratrol with gelfoam as the carrier to enable bone regeneration by determining the radiographic changes and changes in the biomarkers of bone mineralization when compared to normal socket healing.

AIM: The aim of this study is to assess and compare the efficacy of resveratrol in alveolar bone growth and regeneration in extraction sockets when compared to normal socket healing

OBJECTIVES:

1. To evaluate postoperative hard tissue healing
2. To evaluate postoperative pain
3. To evaluate postoperative swelling
4. To evaluate postoperative soft tissue healing

5. To evaluate the change in postoperative salivary alkaline phosphatase levels

MATERIALS AND METHODS

Study Design and Setting

This study with a split-mouth design was conducted on 16 patients, including 50 extraction sockets, which were equally divided into two groups of 25 sockets each.

Inclusion criteria included:

1) Patients indicated for bilateral extraction of teeth

2) Patients aged 18-45 years

3) Patients willing to give consent for the study

Exclusion criteria included:

1) Medically compromised patients (diabetes, hypertension, thyroid disorders) and systemically contraindicated for surgery.

2) Patient reported with Bleeding Disorders.

3) Reported allergy or hypersensitivity to resveratrol.

4) Presence of Bone Pathology (Paget's disease, Osteoporosis, Osteopetrosis)

5) Patients indicated for surgical extraction of tooth

6) Factors affecting bone healing capacity - smoking, alcoholism, anaemia, hormonal effects, nutritional condition, vascular condition, local growth factors

Eligible patients were enrolled after explaining the surgical procedure and after obtaining written informed consent. Detailed case history and routine hematological investigations were completed prior to the procedure.

Clinical Procedure

All extractions were performed under local anesthesia. Following extraction, the socket was irrigated with sterile saline.

In the study group, Resveratrol (99.99% pure powder) (Figure 1) was mixed with normal saline and incorporated into an absorbable gelatin sponge (Figure 2), which was placed into the extraction socket. In the control group, a gelatin sponge soaked only in 0.9% normal saline was placed. Closure was performed using a Figure-of-8 suture technique with 3-0 silk in both groups (Figure 3). Immediate postoperative intraoral periapical radiographs (IOPA) were obtained. Patients were instructed to apply pressure with a gauze pack for 30 minutes. Antibiotics (Cap. Amoxycillin 500mg TID for five days) and analgesics (Tab. Aceclofenac 100mg + Paracetamol 325 mg BID for three days) were prescribed only in 1 patient who underwent bilateral upper third molar extraction. The remaining 15 patients

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underwent orthodontic extractions and were only prescribed analgesics (Tab. Paracetamol 500mg SOS).

OUTCOME MEASURES

Pain Assessment

Pain intensity was evaluated clinically using the Visual Analog Scale (VAS) on days 1 and 7 post-extraction. The scale is scored from 0-10, with 0 indicating no pain and a score of 10 indicating unbearable pain.

Swelling Assessment

Facial swelling was measured on postoperative days 1 and 7 using two linear measurements: horizontal distance from the corner of the mouth to the tragus and vertical distance from the lateral canthus to the anatomical angle of the mandible. Measurements were compared between the study and control sites.

Soft Tissue Healing

Healing was assessed using the Landry Healing Index on postoperative days 1 and 7.

Biochemical Analysis

Unstimulated saliva samples were collected (Figure 4) and centrifuged at 3000 rpm. The supernatant was removed, and the saliva sample was mixed with AGD Clinipak kinetic ALP reagent and analyzed using an auto-analyzer (Figure 5). (Salivary Alkaline Phosphatase) S-ALP levels were recorded as displayed on the auto analyzer monitor on postoperative days 1 and 7 and compared for the changes.

Radiographic Evaluation

IOPA radiographs were taken immediately, at 4 weeks, and at 8 weeks (Figure 6). Images were digitized in ImageJ software and assessed. Socket outlines were standardized using immediate postoperative references, and mean gray values were recorded and compared between the two groups. (Figure 7)

Cone Beam Computerised Tomography (CBCT) imaging was performed at 8 weeks postoperatively. Bone density was assessed and compared in Hounsfield Units (HU) in MicroDICOM viewer software, and socket dimensions were measured using stable bony landmarks for reference. (Figure 8)

RESULTS

Out of the 16 patients (50 sites) selected for the study, the patients had a mean age of 21.75 ± 6.26 years.

Postoperative pain ($p = 1.00$), Soft tissue swelling ($p = 0.80$), and Soft tissue healing ($p = 0.75$) were similar in both groups on Days 1 and 7, with the difference being statistically insignificant.

On Day 1, the mean S-ALP level was 25.61 ± 4.44 IU, which increased to 35.57 ± 4.86 IU ($p = <0.001$) on Day 7, displaying statistically significant results. (Table 1)

On evaluation of Bone Mineral Density (BMD) in CBCT at the end of 8 weeks, the mean BMD was 334.04 ± 124.57 HU in the study group and 264.04 ± 128.02 HU in the control group ($p = 0.026$), with the results being statistically significant, indicating that the study group had denser bone formation in comparison to the control group.

In the CBCT analysis, the mean socket size was 28.05 ± 3.49 mm in the study group and 31.75 ± 4.32 mm in the control group ($p < 0.001$), with the difference being statistically significant, showing the average difference in size of the socket is lower in the study group. (Table 2)

Parameter	Timeline	Group	Mean	SD	P value
Pain score (VAS)	Day 1	Study	.6875	.60208	1.0
		Control	.6875	.60208	
	Day 7	Study	.0000	.00000*	*
		Control	.0000	.00000*	
Soft Tissue Healing (Landry's index)	Day 1	Study	3.5000	.5164	0.56
		Control	3.3750	.5000	
	Day 7	Study	4.3125	.4787	0.75
		Control	4.1875	.7500	
Soft tissue swelling (in cm)	Day 1 Vertical	Study	10.1250	.59161	0.42
		Control	9.9375	.70415	
	Day 1 Horizontal	Study	11.3438	.76852	0.80
		Control	11.2813	.60467	
	Day 7 Vertical	Study	10.1250	.59161	0.35
		Control	9.9063	.71224	
	Day 7 Horizontal	Study	11.3438	.76852	0.80
		Control	11.2813	.60467	
Serum ALP (IU/dL)	Day 1		25.6081	4.44370	<0.001
	Day 7		35.5706	4.85606	

Table 1 : Intergroup comparison of clinical data

Parameter	Timeline	Group	Mean	SD	P value
IOPA Greyscale Values	Immediate	Study	72.7132	30.12619	<0.001
	4 weeks		61.8856	25.63253	
	8 weeks		101.1392	32.54961	
	Immediate	Control	61.4052	26.53885	0.092
	4 weeks		57.9340	25.57038	
	8 weeks		76.3100	30.95600	
Bone Mineral Density (HU)	8 weeks	Study	334.0423	124.56893	0.026
		Control	264.0412	128.01781	
Socket Size (mm)	8 weeks	Study	28.0538	3.48508	<0.001
		Control	31.7500	4.32373	

Table 2 : Intergroup comparison of radiological measurements

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Figure 1 : Resveratrol Powder



Figure 2 : Absorbable gelatin sponge

Figure 3A : Material placed and secured using suture in upper arch



Figure 3B : Material placed and secured using suture in lower arch

Figure 4 :

Figure 5 :

Figure 6 :

Figure 7 :

Figure 8 :



Figure 4: Processing saliva sample for S-ALP

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Figure 5: Auto analyser for checking S-ALP levels



Figure 6: IOPAs obtained for evaluation

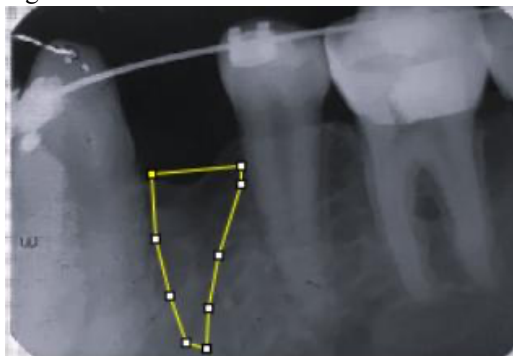


Figure 7: IOPA evaluation of mean greyscale values

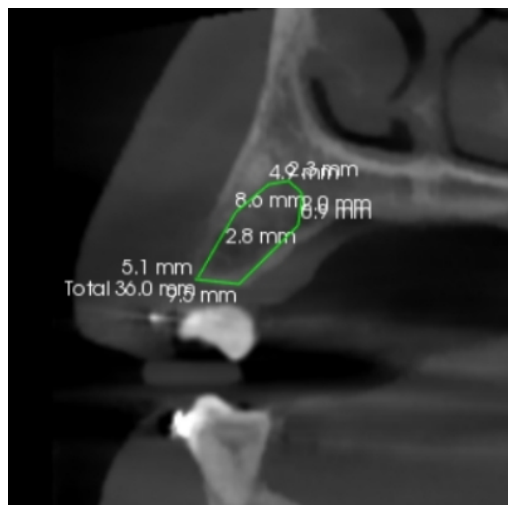


Figure 8: Measuring of BMD and socket size in CBCT

DISCUSSION

Bone is a dynamic hard connective tissue that constantly undergoes renewal. (13) Following tooth extraction or avulsion, rapid bone resorption occurs. This resorption is likely due to factors such as lack of functional loading, reduced blood supply, local inflammatory responses, and unfavorable pressure from dental prostheses. Bone regeneration is most commonly required to facilitate implant placement in edentulous patients. (13)

Osteoblast differentiation is controlled by specific transcription factors because MSCs have the potential to transform into different cell types. Among these regulatory factors, runt-related transcription factor 2 (RUNX2) directs MSCs toward osteoblast formation. Both local and systemic factors can regulate the activity of transcription factors involved in bone formation.

Different types of bone graft materials are used to reduce the alveolar bone loss that normally occurs after tooth extraction and to maintain adequate bone for future implant placement. Each material has its own biological advantages and limitations. Clinically, these materials are placed directly into fresh extraction sockets and are often covered with barrier membranes or soft tissue grafts to protect the graft and promote optimal healing, with the goal of preserving ridge dimensions and creating favorable conditions for later implant placement. (24)

Studies have shown that resveratrol, a natural antioxidant, not only decreases bone resorption but also supports osteoblast growth and increases vitamin D receptor expression in

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bone marrow precursor cells. It has also been linked to improvements in BMD, improved formation of bone, and higher levels of bone-related proteins such as BMPs and osteopontin. (20)

Resveratrol (trans-3,4',5-trihydroxystilbene) is a naturally sourced polyphenolic compound from the stilbene group isolated from *Veratrum grandiflorum*. It is commonly found in dietary sources such as red wine and various fruits, including grapes, cocoa, berries, nuts, and certain traditional medicinal plants used in Asia. (13)

Resveratrol is known to have several biological benefits, such as anti-inflammatory, anti-cancer, antioxidant, and anti-aging effects, along with protective actions on the heart and bones. Specifically, resveratrol has been linked to bone health by supporting new bone formation and reducing bone loss seen in osteoporosis and age-related resorption.

This study was done to assess the effect of a resveratrol-based intervention on healing after tooth extraction using clinical observations, biochemical markers, and radiographic evaluation.

In this study, early postoperative parameters such as swelling and pain were similar in both the study and control groups. Measurements of swelling in both vertical and horizontal directions on Days 1 and 7 did not show any statistically significant difference. This indicates that resveratrol did not have a strong effect on immediate postoperative oedema. Pain scores were also identical in both groups on Day 1 and reduced to zero by Day 7, suggesting that local resveratrol did not produce a noticeable analgesic effect.

These results were comparable to an experiment by Gunti N et al., where the effects of resveratrol were studied by local application in mandibular horizontally impacted third molars. They applied resveratrol and gelatin membrane in the study group and plain gelatin membrane in the control group. Both the VAS scores as well as postoperative swelling were significantly reduced in the study group. In this study, pain and swelling were identical in both groups. Moreover, the study group containing resveratrol also had improved BMD when compared to the control side. (25)

Soft tissue healing, evaluated using Landry's healing index, improved significantly within both groups from Day 1 to Day 7, showing that normal mucosal healing occurred. However, the comparison between the groups was not

significantly different, which means that resveratrol did not significantly speed up soft tissue repair in the first week.

ALP can be assessed from the serum, saliva, and GCF. Saliva is widely used as a diagnostic fluid similar to serum. Variations in serum ALP levels are often mirrored in salivary measurements. (11) Bone-specific ALP is linked to bone formation because it hydrolyzes inorganic pyrophosphate, thereby influencing osteoblast activity and promoting mineralization. (11)

In this study, S-ALP levels increased significantly from 25.61 ± 4.44 IU on Day 1 to 35.57 ± 4.86 IU on Day 7. ALP is an important marker of bone formation, and its increase indicates active osteoblastic activity and mineralization within the healing socket. Although intergroup comparison was not performed as the study has a split-mouth design, this increase in S-ALP supports the radiographic findings of improved bone formation in the resveratrol group.

Ozcan-Kucuk et al evaluated the effects of resveratrol administration intraperitoneally on socket healing post-extraction of the tooth in both healthy rats and rats treated with Cyclosporin A. Their findings showed increased expression of bone formation markers, including OCN and osteopontin, along with improved alveolar socket healing in both groups. (30)

Similarly, an in vitro study by Min and co-workers observed the effect of 50- μ M resveratrol on extraction sockets and assessed new bone formation. They observed that resveratrol enhances the functional activity of hPDL cells and increases osteoblastic activity within the healing socket. (10)

Mah and colleagues (2008) performed an in-vitro study examining the relationship between CBCT grey-scale values and HU, concluding that CBCT grey-scale measurements could provide a simple estimate of HU. (34)

In this study, CBCT evaluation showed statistically significantly higher BMD in the study group (334.04 ± 124.57 HU) compared with the control group (264.04 ± 128.02 HU). The study group also displayed statistically significantly lower socket size (28.05 ± 3.49 mm) when compared to the control group (31.75 ± 4.32 mm). Higher bone density suggests better bone formation and mineralization, while reduced socket size indicates faster bone fill and remodeling. These findings agree with experimental evidence

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showing that resveratrol promotes bone regeneration through molecular pathways that enhance osteogenic activity and angiogenesis. Even though early inflammation was similar in both groups, resveratrol improved the quality of hard tissue healing.

In the split-mouth prospective study by Saifi AM et al, the effect of locally applied simvastatin on extraction-socket healing was evaluated using intraoral periapical radiographs (IOPAs) to assess bone mineral density changes. (36)

In the current study, when IOPAs were evaluated for average greyscale values, there was no difference between groups immediately after extraction or at 4 weeks. But a statistically significant improvement (101.13 ± 32.54 in the study group and 76.31 ± 30.95 in the control group) was seen at 8 weeks in the study group. This delayed improvement reflects the normal process of bone healing, where mineralization and maturation occur several weeks after extraction. The increased grayscale values at 8 weeks indicate more advanced bone formation in the resveratrol group. Repeated measures analysis within groups also showed significant radiographic improvement in the resveratrol group but not in controls, confirming its positive effect on bone regeneration.

Overall, the findings suggest that the molecular effects of resveratrol appear to enhance osteoblast activity, angiogenesis, and mineralization, leading to improved bone density and socket preservation. This pattern is similar to other socket preservation materials that improve bone healing without significantly changing early postoperative swelling or pain. From a clinical perspective, local application of resveratrol may help create better conditions for future implant placement or prosthetic treatment. Because resveratrol is naturally derived and has a good safety profile, it may serve as a cost-effective and biologically active adjunct to conventional socket preservation methods. Incorporating resveratrol into gelatin sponges or other scaffolds can allow localized delivery with minimal systemic exposure.

Positives of the study

The study was conducted as a split-mouth design, which provided a strong and reliable research framework. A clearly stated objective, specific inclusion and exclusion criteria, and usage of objective outcome measures further improved the accuracy as well as the credibility of results.

Limitations of the study

The sample size was relatively small, which may be responsible for limiting the strength of the conclusions. S-ALP levels were not compared between groups, which limits understanding of the exact mechanism. Patient-related factors such as oral hygiene and nutrition were not controlled.

Future research should include larger randomized studies with longer follow-up, histological evaluation of bone formation, and measurement of additional biomarkers such as OCN, VEGF, and inflammatory cytokines to better understand how resveratrol improves bone healing.

Within the limits of this study, resveratrol significantly improved radiographic bone regeneration, as shown by higher CBCT bone density, smaller socket size, and better 8-week IOPA grayscale values, while it did not significantly affect postoperative swelling, pain, or early soft tissue healing. These findings suggest that resveratrol is a useful adjunct for improving bone healing after tooth extraction and deserves further investigation in oral and maxillofacial regenerative therapy.

No complications such as dry socket, infection, or sinus drainage were noted during follow-up. The study also found that placing resveratrol in the extraction sockets promoted better bone formation.

CONCLUSION

In the present study, the effects of resveratrol were observed in post-extraction sockets and compared with the normal healing sequelae. The differences between the study and control group were analysed clinically, biochemically, and radiographically. The intervention demonstrated no significant differences in soft tissue healing, postoperative pain and swelling; highlighting the fact that resveratrol caused no adverse effects. A statistically significant increase in S-ALP levels signified the increase in bone turnover. Statistically significant increase in BMD in greyscale values and reduction in socket size indicated greater bone regeneration in the study group when in comparison to control group. These results suggested in favor of the fact that local application of resveratrol improves bone regeneration of the extraction socket when compared to normal hard tissue healing.

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DECLARATIONS

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No funding was received for this study.

Conflict of Interest

The author declares no conflict of interest.

Ethical Approval

The study was in accordance with the principles of the Helsinki declaration (World Health Authority – 1975).

Ethical approval was obtained from the Institutional Ethical Committee and Review Board (Approval No: SRMDC/IRB/2023/MDS/No.403).

Informed Consents

Obtained

REFERENCES

- 1) Sayyed Z, Babasaheb TV, Khan MH, Suryavanshi MR, Shaikh O, Ali SF. Comparative Evaluation of Dexamethasone and Methylprednisolone for Pain, Swelling, and Trismus After Mandibular Third Molar Surgery: A Prospective Randomized Clinical Study. *Oral Sphere J. Dent. Health Sci.* 2026;2(2):63-78. doi: 10.63150/osjdhs.2026.11
- 1) Harsha G, Madhavi S, Arthi S, Haritha S. Evaluation of efficacy of simvastatin in bone regeneration following local application in third molar extraction socket: a randomized controlled trial. *Natl J Maxillofac Surg.* 2023 May–Aug;14(2):286-293. doi:10.4103/njms.njms_317_21.
- 2) Hong CE, Lee JY, Choi J, Joo JY. Prediction of the alveolar bone level after the extraction of maxillary anterior teeth with severe periodontitis. *J Periodontal Implant Sci.* 2015 Dec;45(6):216-222. doi:10.5051/jpis.2015.45.6.216
- 3) Gupta S, Del Fabbro M, Chang J. The impact of simvastatin intervention on the healing of bone, soft tissue, and TMJ cartilage in dentistry: a systematic review and meta-analysis. *Int J Implant Dent.* 2019 Apr 9;5(1):17. doi:10.1186/s40729-019-0168-4
- 4) Bahadur R, Kashwani R, Sawhney H, Kumar S, Gupta G. Platelet rich fibrin integration in impacted third molar extraction sockets for bony regeneration: a case report. *J Dent Probl.* 2024;6(1):46-51. Doi : <https://doi.org/10.18231/j.jdp.2024.011>
- 5) Ren ZQ, Zheng SY, Sun Z, Luo Y, Wang YT, Yi P, Li YS, Huang C, Xiao WF. Resveratrol: molecular mechanisms, health benefits, and potential adverse effects. *MedComm* (2020). 2025 Jun 11;6(6):e70252. doi:10.1002/mco2.70252
- 6) Katara A, Waghmare M, Kadakia N, Samson S, Minhas R. A case series of treatment of oral mucosal lesions using diode

lasers. *Scientific Dental Journal.* 2021 Jan 1;5(1):47-51.

- 7) Min KK, Neupane S, Adhikari N, Sohn WJ, An SY, Kim JY, An CH, Lee Y, Kim YG, Park JW, Lee JM, Kim JY, Suh JY. Effects of resveratrol on bone-healing capacity in the mouse tooth extraction socket. *J Periodontal Res.* 2020 Apr;55(2):247-257. doi:10.1111/jre.12710.
- 8) Abhangi KK, Choudhari SR, Butala PB, Goyal SR, Yadav TG. Salivary total protein and alkaline phosphatase activity as biomarkers for skeletal maturity and growth prediction in healthy children: an in vivo study. *Int J Clin Pediatr Dent.* 2023;16(4):603-607. doi:10.5005/jp-journals-10005-2629.
- 9) Murgia D, Mauceri R, Campisi G, De Caro V. Advance on resveratrol application in bone regeneration: Progress and perspectives for use in oral and maxillofacial surgery. *Biomolecules.* 2019 Mar 8;9(3):94.
- 10) Lin Q, Huang YM, Xiao BX, Ren GF. Effects of resveratrol on bone mineral density in ovariectomized rats. *International journal of biomedical science: IJBS.* 2005 Jun;1(1):76.
- 11) İskender, Muhsin Fırat, Müge Çına, Şevket Tolga Çamlı, İbrahim Metin Çiriş, and Ramazan Oğuz Yüceer. 2024. "Evaluation of the Effects of Locally Applied Resveratrol and Cigarette Smoking on Bone Healing" *Applied Sciences* 14, no. 15: 6411.
- 12) Kim YK, Ku JK. Extraction socket preservation. *J Korean Assoc Oral Maxillofac Surg.* 2020;46(6):435-439. doi:10.5125/jkaoms.2020.46.6.435.
- 13) Gunti N, Prathigudupu RS, Prasad LK, et al. Evaluating the efficacy of transresveratrol in extraction socket of impacted mandibular third molar: a double-blind study. *World J Dent.* 2023;14(10):869-876.
- 14) Ozcan-Kucuk A, Alan H, Gul M, Yolcu U. Evaluating the effect of resveratrol on the healing of extraction sockets in cyclosporine A-treated rats. *J Oral Maxillofac Surg.* 2018;76:1404-1413.
- 15) Mah P, Reeves TE, McDavid WD. Deriving Hounsfield units using grey levels in cone beam computed tomography. *Dentomaxillofac Radiol.* 2010;39:323-335. doi:10.1259/dmfr/19603304.
- 16) Saifi AM, Giraddi GB, Ahmed N. Healing of extraction socket following local application of simvastatin: a split mouth prospective study. *J Oral Biol Craniofac Res.* 2017;7(2):106-112. doi:10.1016/j.jobcr.2017.04.001.