How to Cite:
Krishnan, S., & Periasamy, S. (2021). Effectiveness of knotless barbed sutures as an intraoral wound closure agent in Oral and Maxillofacial Surgery: A systematic review. *International Journal of Health Sciences*, *5*(S2), 395–416.
https://doi.org/10.53730/ijhs.v5nS2.5862

Effectiveness of knotless barbed sutures as an intraoral wound closure agent in Oral and Maxillofacial Surgery: A systematic review

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***Abstract*---**Surgical knots that are placed during conventional suturing are needed to anchor the suture to allow it to maintain tissue approximation at the wound margin. They reduce the effective volume and tensile strength of all sutures by thinning and stretching the material as well as creating an uneven distribution of tension across the wound with the higher tension burden placed at the knots. The objective of this systematic review is to evaluate the effectiveness of knotless barbed sutures on intraoral wound healing and operative time in Oral and Maxillofacial Surgery procedures. The Data Bases of PubMed, Cochrane, and Google Scholar were searched for the related topics along with a complimentary manual search of all oral surgery journals till December 2020. Articles were selected based on the inclusion criteria, which included all RCTs. The knotless suture device consists of tiny barbs along its entire length surface, which arise from opposite directions on either side of a central non-barbed segment allowing the suture to be self-anchoring, allowing the close approximation of tissue while resisting the migration that can occur with swelling. Therefore, they may be an ideal alternative to eliminate the above-mentioned limitations of conventional suturing. The aim of this systematic review is to evaluate in an evidence-based way, the effectiveness of knotless barbed sutures as an intraoral wound closure agent as they reduce operative time and improve wound healing in patients who have undergone oral and maxillofacial surgery procedures.

International Journal of Health Sciences ISSN 2550-6978 E-ISSN 2550-696X © 2021.
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Manuscript submitted: 18 Sept 2021, Manuscript revised: 9 Nov 2021, Accepted for publication: 12 Dec 2021

***Keywords*---**oral and maxillofacial surgery, knotless sutures, barbed sutures, intraoperative time, wound healing, polyglactin 910 suture.

Introduction

Maxillofacial surgical procedures involve intraoral wound closure which may be traumatic or surgical incisions. (1). Meticulous closure of intraoral incisions has an important role in determining the overall surgical outcome (2). Suturing remains the most commonly employed method of wound closure in intraoral surgery, and its objectives include the following; anatomic re-approximation of tissues, hemostasis and prevention of wound contamination through leakage or entrapment of food. (3). The suturing must provide an ideal tissue seal and wound approximation that prevents the underlying implants or grafts from getting infected. (4) Conventional suturing requires placement of knots to secure the suture material (5,6) to the tissues and to maintain adequate tension at the approximated wound margin. Surgical knots are simply a necessary evil needed to anchor smooth suture to allow it to function in its role in tissue reapproximation. (7). Suturing after maxillofacial surgery procedures presents with the following technical difficulties: restricted access, difficulty in instrumentation, difficulty in securing knot. (8) As surgical knots act as a nidus of accumulation of food debris, they can lead to numerous knot related complications such as infection and soft tissue irritation. (1) (9). Literature also reveals that surgical knots over the wound can cause ischemia due to additional pressure which predisposes the wound to infection. Improper suturing leads to complications such as wound dehiscence, infection, and post-operative pain.(8)

Knotless suturing is an innovative method of wound closure used in the fields of bariatric surgery(10) , abdominoplasty (11), facial rejuvenation procedures (12), arthrotomy (13), laparoscopic myomectomy (14), partial nephrectomy(15) , and in various minimally invasive procedures. The configuration allows the suture to be self-anchoring, allowing close approximation of tissue while resisting the migration that can occur with swelling. They are a promising alternative to vicryl for intraoral wound closure. (16) From this study it is concluded that knotless barbed sutures are effective as an intraoral wound closure agent thereby reducing intraoperative wound closure time and improving wound healing in the patients who have undergone maxillofacial surgery procedures.

Aim

The aim of this systematic review was to analyse the existing literature to assess the effectiveness of knotless barbed sutures as an intraoral wound closure agent in Oral and Maxillofacial Surgery

Structured question

Are knotless barbed sutures effective as an intraoral wound closure agent in patients undergoing Oral and Maxillofacial Surgery procedures?

PICO analysis

- Population : Patients undergoing Oral and Maxillofacial Surgery procedures
- Intervention : Knotless Barbed Sutures
- Comparison : Conventional vicryl sutures
- Outcome : Intraoperative wound closure time

Materials and Methods

Inclusion criteria
Criteria for considering studies for the Review

- Types of studies -
  - Randomized controlled trials
  - Clinical trials.
- Types of Participants –
  Patients undergoing Oral and Maxillofacial Surgery procedures
- Types of Intervention
  Intraoperative wound closure time is evaluated using knotless barbed sutures as a intraoral wound closure agent for patients undergoing oral and maxillofacial surgery procedures.
- Types of Comparison
  Intraoperative wound closure time is evaluated using conventional vicryl sutures as an intraoral wound closure agent for patients undergoing oral and maxillofacial surgery procedures.
- Types of Outcome Measures
  Intraoperative wound closure time is evaluated for patients undergoing oral and maxillofacial surgery procedures.

Exclusion criteria
The following studies were excluded,

- Case reports / Case series
- Review articles
- Animal studies
- Invitro studies
- Studies not meeting the inclusion criteria
- Literatures in other languages which cannot be translated by the reviewer were excluded.

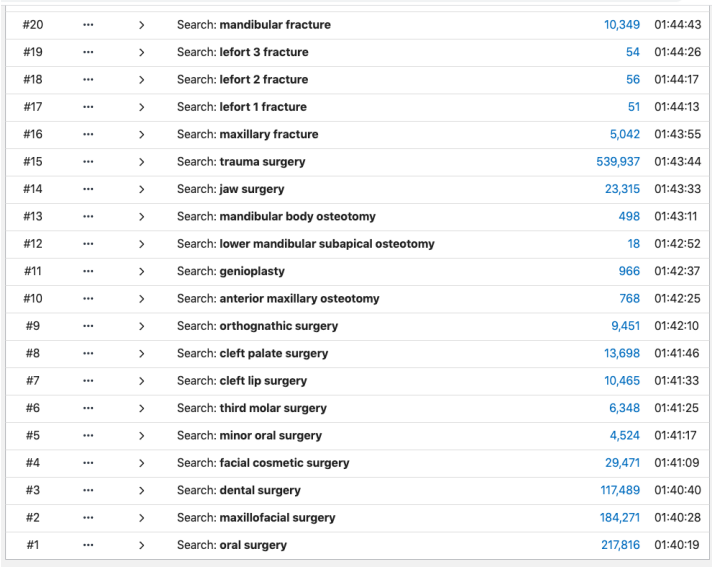
Sources used
The Data Bases of PubMed Advanced Search, Cochrane Database of Systematic Review and Google scholar were searched for the related topics. We used free-text terms to search the following journals”

- British Journal of Oral and Maxillofacial Surgery
- International Journal of Oral and Maxillofacial Surgery
- Journal of Oral and Maxillofacial Surgery
- Journal of Cranio Maxillofacial Surgery

- Quintessence International Journal

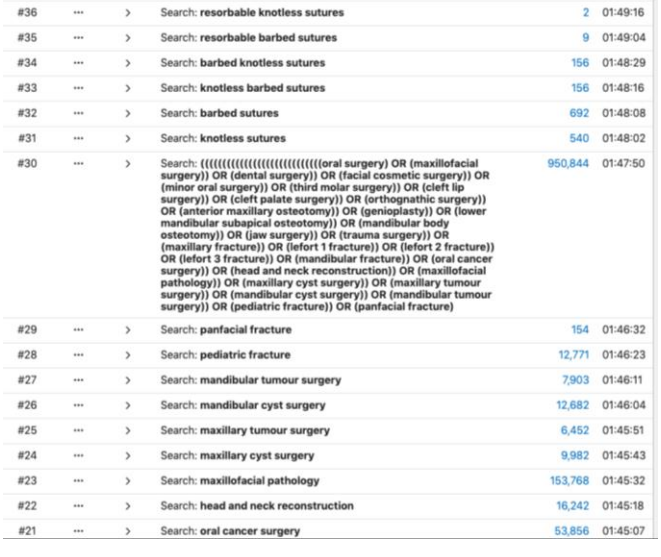
Only articles in English and human species were applied during the electronic search to include all the possible clinical trials that are relevant for the search phase of the systematic review. Reference list of the identified randomized trials were also checked for possible additional studies.

Search Methodology

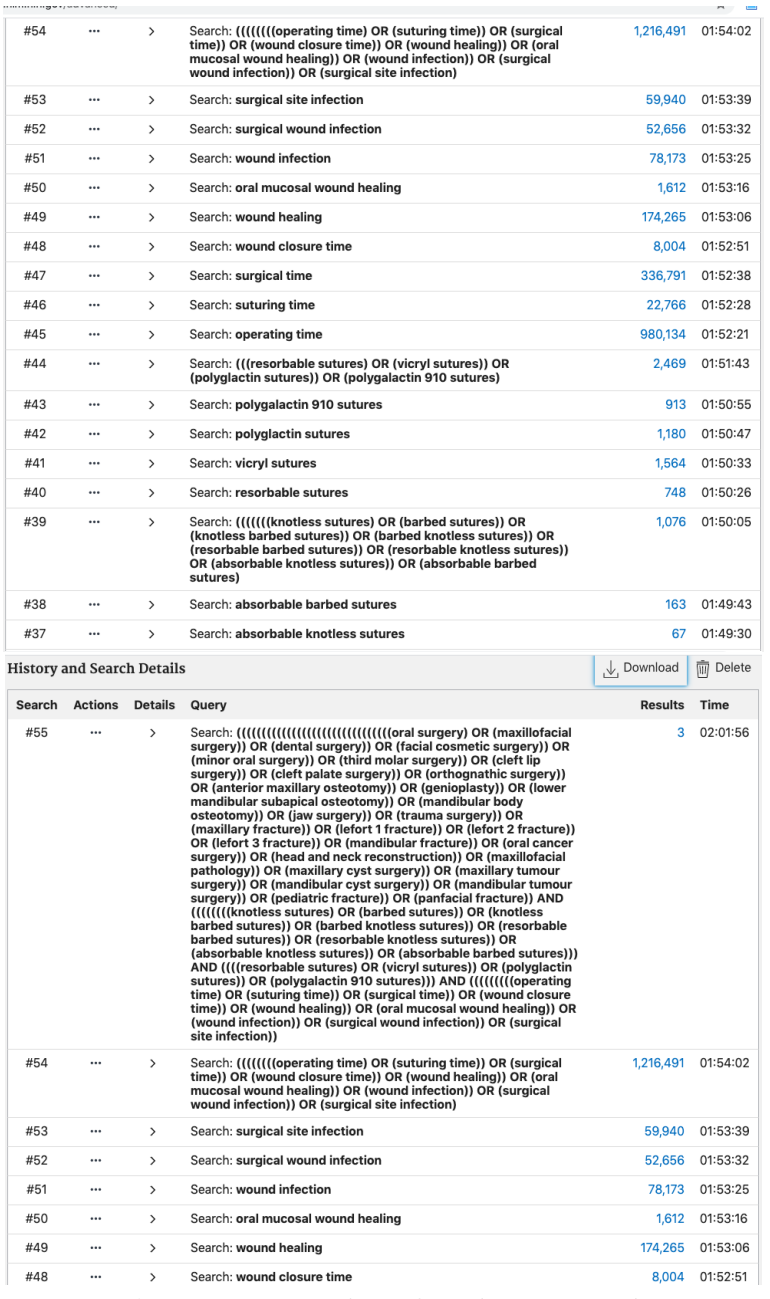


#20	···	›	Search: **mandibular fracture**	10,349	01:44:43
#19	···	›	Search: **lefort 3 fracture**	54	01:44:26
#18	···	›	Search: **lefort 2 fracture**	56	01:44:17
#17	···	›	Search: **lefort 1 fracture**	51	01:44:13
#16	···	›	Search: **maxillary fracture**	5,042	01:43:55
#15	···	›	Search: **trauma surgery**	539,937	01:43:44
#14	···	›	Search: **jaw surgery**	23,315	01:43:33
#13	···	›	Search: **mandibular body osteotomy**	498	01:43:11
#12	···	›	Search: **lower mandibular subapical osteotomy**	18	01:42:52
#11	···	›	Search: **genioplasty**	966	01:42:37
#10	···	›	Search: **anterior maxillary osteotomy**	768	01:42:25
#9	···	›	Search: **orthognathic surgery**	9,451	01:42:10
#8	···	›	Search: **cleft palate surgery**	13,698	01:41:46
#7	···	›	Search: **cleft lip surgery**	10,465	01:41:33
#6	···	›	Search: **third molar surgery**	6,348	01:41:25
#5	···	›	Search: **minor oral surgery**	4,524	01:41:17
#4	···	›	Search: **facial cosmetic surgery**	29,471	01:41:09
#3	···	›	Search: **dental surgery**	117,489	01:40:40
#2	···	›	Search: **maxillofacial surgery**	184,271	01:40:28
#1	···	›	Search: **oral surgery**	217,816	01:40:19

Figure 1. Screenshot of PubMed search



#36	···	›	Search: **resorbable knotless sutures**	2	01:49:16
#35	···	›	Search: **resorbable barbed sutures**	9	01:49:04
#34	···	›	Search: **barbed knotless sutures**	156	01:48:29
#33	···	›	Search: **knotless barbed sutures**	156	01:48:16
#32	···	›	Search: **barbed sutures**	692	01:48:08
#31	···	›	Search: **knotless sutures**	540	01:48:02
#30	···	›	Search: **((((((((((((((((((((((((((((((oral surgery) OR (maxillofacial surgery)) OR (dental surgery)) OR (facial cosmetic surgery)) OR (minor oral surgery)) OR (third molar surgery)) OR (cleft lip surgery)) OR (cleft palate surgery)) OR (orthognathic surgery)) OR (anterior maxillary osteotomy)) OR (genioplasty)) OR (lower mandibular subapical osteotomy)) OR (mandibular body osteotomy)) OR (jaw surgery)) OR (trauma surgery)) OR (maxillary fracture)) OR (lefort 1 fracture)) OR (lefort 2 fracture)) OR (lefort 3 fracture)) OR (mandibular fracture)) OR (oral cancer surgery)) OR (head and neck reconstruction)) OR (maxillofacial pathology)) OR (maxillary cyst surgery)) OR (maxillary tumour surgery)) OR (mandibular cyst surgery)) OR (mandibular tumour surgery)) OR (pediatric fracture)) OR (panfacial fracture)**	950,844	01:47:50
#29	···	›	Search: **panfacial fracture**	154	01:46:32
#28	···	›	Search: **pediatric fracture**	12,771	01:46:23
#27	···	›	Search: **mandibular tumour surgery**	7,903	01:46:11
#26	···	›	Search: **mandibular cyst surgery**	12,682	01:46:04
#25	···	›	Search: **maxillary tumour surgery**	6,452	01:45:51
#24	···	›	Search: **maxillary cyst surgery**	9,982	01:45:43
#23	···	›	Search: **maxillofacial pathology**	153,768	01:45:32
#22	···	›	Search: **head and neck reconstruction**	16,242	01:45:18
#21	···	›	Search: **oral cancer surgery**	53,856	01:45:07



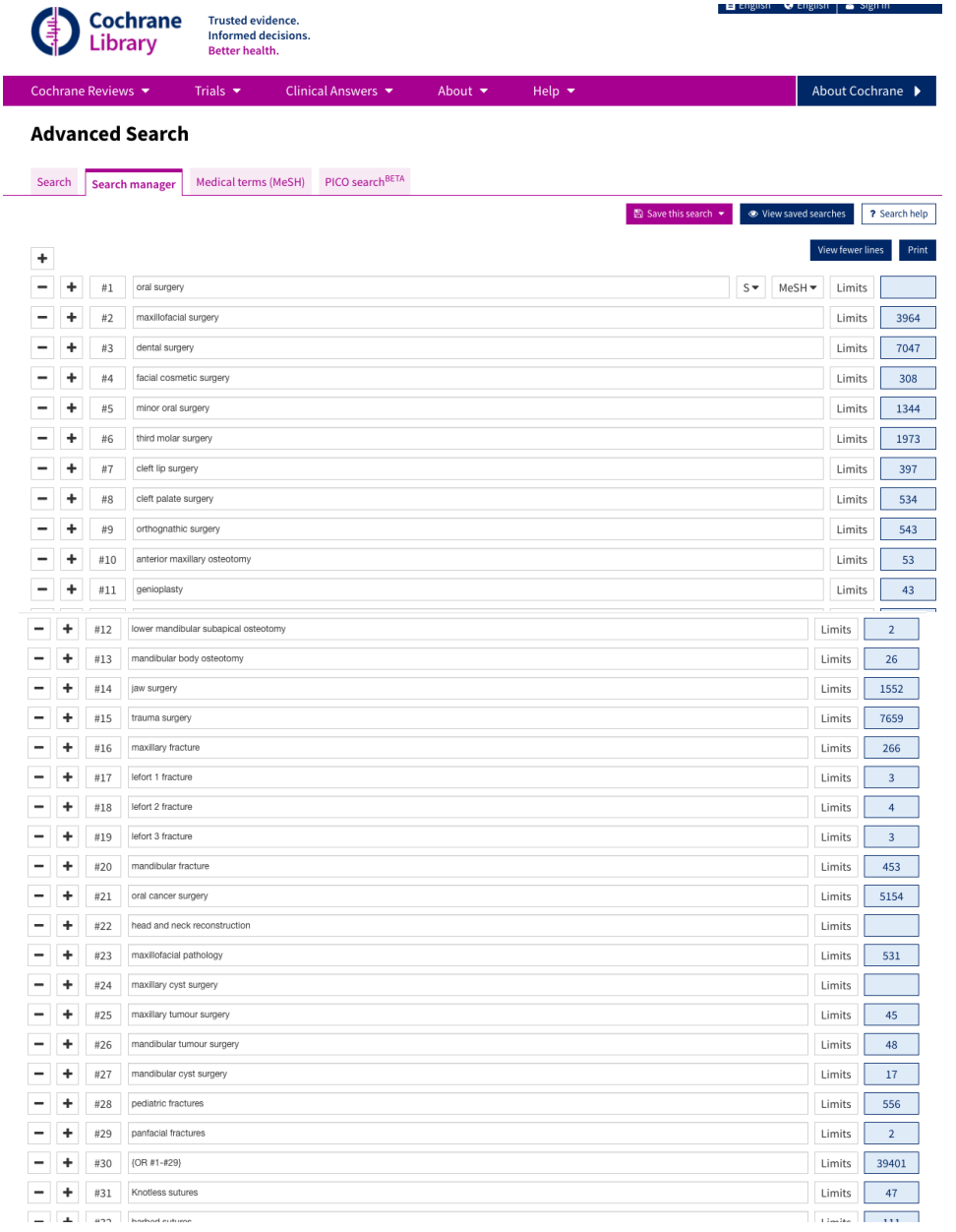
#54	···	›	Search: **(((((((operating time) OR (suturing time)) OR (surgical time)) OR (wound closure time)) OR (wound healing)) OR (oral mucosal wound healing)) OR (wound infection)) OR (surgical wound infection)) OR (surgical site infection)**	1,216,491	01:54:02
#53	···	›	Search: **surgical site infection**	59,940	01:53:39
#52	···	›	Search: **surgical wound infection**	52,656	01:53:32
#51	···	›	Search: **wound infection**	78,173	01:53:25
#50	···	›	Search: **oral mucosal wound healing**	1,612	01:53:16
#49	···	›	Search: **wound healing**	174,265	01:53:06
#48	···	›	Search: **wound closure time**	8,004	01:52:51
#47	···	›	Search: **surgical time**	336,791	01:52:38
#46	···	›	Search: **suturing time**	22,766	01:52:28
#45	···	›	Search: **operating time**	980,134	01:52:21
#44	···	›	Search: **(((resorbable sutures) OR (vicryl sutures)) OR (polyglactin sutures)) OR (polygalactin 910 sutures)**	2,469	01:51:43
#43	···	›	Search: **polygalactin 910 sutures**	913	01:50:55
#42	···	›	Search: **polyglactin sutures**	1,180	01:50:47
#41	···	›	Search: **vicryl sutures**	1,564	01:50:33
#40	···	›	Search: **resorbable sutures**	748	01:50:26
#39	···	›	Search: **(((((((knotless sutures) OR (barbed sutures)) OR (knotless barbed sutures)) OR (barbed knotless sutures)) OR (resorbable barbed sutures)) OR (resorbable knotless sutures)) OR (absorbable knotless sutures)) OR (absorbable barbed sutures)**	1,076	01:50:05
#38	···	›	Search: **absorbable barbed sutures**	163	01:49:43
#37	···	›	Search: **absorbable knotless sutures**	67	01:49:30

History and Search Details

Download Delete

Search	Actions	Details	Query	Results	Time
#55	···	›	Search: **((oral surgery) OR (maxillofacial surgery)) OR (dental surgery)) OR (facial cosmetic surgery)) OR (minor oral surgery)) OR (third molar surgery)) OR (cleft lip surgery)) OR (cleft palate surgery)) OR (orthognathic surgery)) OR (anterior maxillary osteotomy)) OR (genioplasty)) OR (lower mandibular subapical osteotomy)) OR (mandibular body osteotomy)) OR (jaw surgery)) OR (trauma surgery)) OR (maxillary fracture)) OR (lefort 1 fracture)) OR (lefort 2 fracture)) OR (lefort 3 fracture)) OR (mandibular fracture)) OR (oral cancer surgery)) OR (head and neck reconstruction)) OR (maxillofacial pathology)) OR (maxillary cyst surgery)) OR (maxillary tumour surgery)) OR (mandibular cyst surgery)) OR (mandibular tumour surgery)) OR (pediatric fracture)) OR (panfacial fracture)) AND ((((((((knotless sutures) OR (barbed sutures)) OR (knotless barbed sutures)) OR (barbed knotless sutures)) OR (resorbable barbed sutures)) OR (resorbable knotless sutures)) OR (absorbable knotless sutures)) OR (absorbable barbed sutures))) AND ((((resorbable sutures) OR (vicryl sutures)) OR (polyglactin sutures)) OR (polygalactin 910 sutures))) AND (((((((((operating time) OR (suturing time)) OR (surgical time)) OR (wound closure time)) OR (wound healing)) OR (oral mucosal wound healing)) OR (wound infection)) OR (surgical wound infection)) OR (surgical site infection))**	3	02:01:56
#54	···	›	Search: **(((((((operating time) OR (suturing time)) OR (surgical time)) OR (wound closure time)) OR (wound healing)) OR (oral mucosal wound healing)) OR (wound infection)) OR (surgical wound infection)) OR (surgical site infection)**	1,216,491	01:54:02
#53	···	›	Search: **surgical site infection**	59,940	01:53:39
#52	···	›	Search: **surgical wound infection**	52,656	01:53:32
#51	···	›	Search: **wound infection**	78,173	01:53:25
#50	···	›	Search: **oral mucosal wound healing**	1,612	01:53:16
#49	···	›	Search: **wound healing**	174,265	01:53:06
#48	···	›	Search: **wound closure time**	8,004	01:52:51

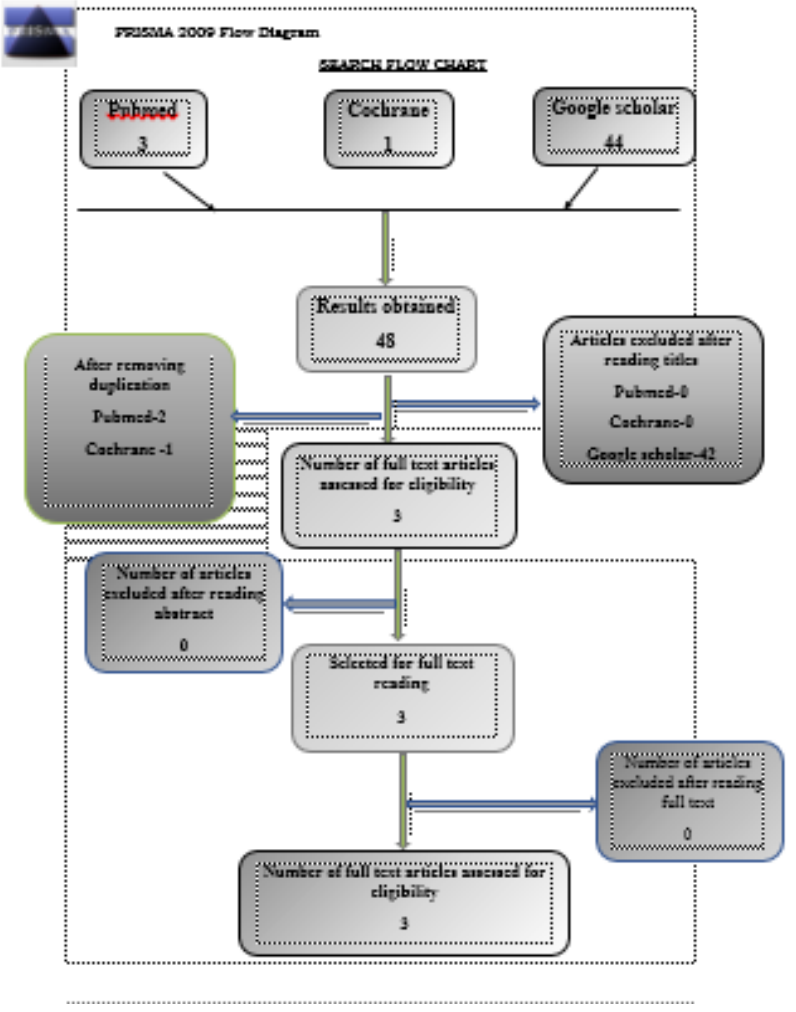
Figure 2. Screenshot of Cochrane search


Cochrane Library
Trusted evidence.
Informed decisions.
Better health.
Cochrane Reviews
Trials
Clinical Answers
About
Help
About Cochrane
Advanced Search
Search
Search manager
Medical terms (MeSH)
PICO search BETA
Save this search
View saved searches
Search help
View fewer lines
Print
#1 oral surgery S MeSH Limits
#2 maxillofacial surgery Limits 3964
#3 dental surgery Limits 7047
#4 facial cosmetic surgery Limits 308
#5 minor oral surgery Limits 1344
#6 third molar surgery Limits 1973
#7 cleft lip surgery Limits 397
#8 cleft palate surgery Limits 534
#9 orthognathic surgery Limits 543
#10 anterior maxillary osteotomy Limits 53
#11 genioplasty Limits 43
#12 lower mandibular subapical osteotomy Limits 2
#13 mandibular body osteotomy Limits 26
#14 jaw surgery Limits 1552
#15 trauma surgery Limits 7659
#16 maxillary fracture Limits 266
#17 lefort 1 fracture Limits 3
#18 lefort 2 fracture Limits 4
#19 lefort 3 fracture Limits 3
#20 mandibular fracture Limits 453
#21 oral cancer surgery Limits 5154
#22 head and neck reconstruction Limits
#23 maxillofacial pathology Limits 531
#24 maxillary cyst surgery Limits
#25 maxillary tumour surgery Limits 45
#26 mandibular tumour surgery Limits 48
#27 mandibular cyst surgery Limits 17
#28 pediatric fractures Limits 556
#29 panfacial fractures Limits 2
#30 {OR #1-#29} Limits 39401
#31 Knotless sutures Limits 47

#32	barbed sutures	Limits	111
#33	knotless barbed sutures	Limits	34
#34	barbed knotless sutures	Limits	34
#35	resorbable barbed sutures	Limits	1
#36	resorbable knotless sutures	Limits	0
#37	absorbable barbed sutures	Limits	35
#38	resorbable barbed sutures	Limits	1
#39	{OR #31-#38}	Limits	124
#40	resorbable sutures	Limits	92
#41	vicryl sutures	Limits	299
#42	polyglactin sutures	Limits	279
#43	polygalactin 910 sutures	Limits	2
#44	{OR #40-#43}	Limits	537
#45	operating time	Limits	8027
#46	suturing time	Limits	1103
#47	surgical time	Limits	41133
#48	wound closure time	Limits	2291
#49	wound healing	Limits	12592
#50	oral mucosal wound healing	Limits	130
#51	wound infection	Limits	11497
#52	surgical wound infection	Limits	7644

#36	resorbable knotless sutures	Limits	0
#37	absorbable barbed sutures	Limits	35
#38	resorbable barbed sutures	Limits	1
#39	{OR #31-#38}	Limits	124
#40	resorbable sutures	Limits	92
#41	vicryl sutures	Limits	299
#42	polyglactin sutures	Limits	279
#43	polygalactin 910 sutures	Limits	2
#44	{OR #40-#43}	Limits	537
#45	operating time	Limits	8027
#46	suturing time	Limits	1103
#47	surgical time	Limits	41133
#48	wound closure time	Limits	2291
#49	wound healing	Limits	12592
#50	oral mucosal wound healing	Limits	130
#51	wound infection	Limits	11497
#52	surgical wound infection	Limits	7644

#53	surgical site infection	Limits	4
#54	{OR #45-#53}	Limits	63368
#55	#30 and #39 and #44 and #54	Limits	1



Data Collection and Analysis

Screening and selection

Electronic search was carried out using the keywords in the Search engines- PubMed, Cochrane and Google Scholar which yielded a total of 48 articles. Hand search yielded two articles which were the same as those obtained in Google scholar. Based on pre-set inclusion and exclusion criteria, the titles of the studies identified from the search were assessed independently by two review authors (Dr. Sneha Krishnan, Prof. Dr. Senthilnathan Periasamy). Conflicts concerning inclusion of the studies were resolved by discussion. Forty two articles were excluded after reading titles. Three titles were identified from the search after excluding one duplication. Abstracts of selected articles were reviewed independently. No articles were excluded after reading the abstract. Full text articles were retrieved for three relevant studies.

The reference list of the full text articles were reviewed for identifying additional studies. Titles of articles relevant to the review were selected by discussion. Quality Assessment criteria to evaluate the studies were decided by two review authors in accordance with CONSORT guidelines. The risk of bias for each study was independently assessed by the review authors and conflicts concerning risk of bias were sorted by discussion.

Data extraction

Data extraction for general characteristics of studies and variables of outcome was done. For each trial the following data were recorded:

- Author and Journal
- Study Design
- Sample Size
- Participants and Group
- Methodology
- Outcome Measures
- Results
- Conclusion

Table 1
Variables of interest

S.No	VARIABLES OF INTEREST
1.	Intraoperative wound closure time

Quality assessment

(Higgins and Green. Cochrane reviewer's hand book 2009). The quality assessment of included trials was undertaken independently as a part of data extraction process. Four main quality criteria were examined.

1. Method of Randomization, recorded as
   a) YES- Adequate as described in the text
   b) NO- Inadequate as described in the text
   c) Unclear in the text
2. Allocation Concealment, recorded as
   a) YES- Adequate as described in the text
   b) NO- Inadequate as described in the text
   c) Unclear in the text
3. Outcome assessors Blinded to intervention, recorded as
   a) YES- Adequate as described in the text
   b) NO- Inadequate as described in the text
   c) Unclear in the text
4. Completeness of Follow up (was there a clear explanation for withdrawals and dropouts in each treatment group) assessed as
   a)YES- Dropouts were explained

b) NO- Dropouts were not explained
c) None- No Dropouts or withdrawals.

Other methodological criteria examined included:

1. Presence or Absence of sample size calculation.
2. Comparability of Groups at the start.
3. Clear Inclusion or Exclusion criteria.
4. Presence or Absence of estimate of measurement error.

Risk of bias in included studies

The study was assessed to have a “High risk” of bias if it did not record a “Yes” in three or more of the four main categories, "Moderate Risk "if two out of four categories did not record a "Yes", and “Low Risk” if all the four categories recorded if randomization assessor, Blinding and Completeness of follow up were considered Adequate. In case of non-randomized and clinical trials without control group, it is recorded as not applicable.

Results

Table 2
General characteristics of the studies

S. No	Author	Year	Study design	Sample size	Age	Technique Used	Method of Evaluation
1	A.K.Sharma et al	2020	Randomised controlled clinical study	N=40	20-40yrs	One group receiving knotless barbed sutures and another group receiving conventional vicryl sutures	Intraoperative wound closure time Postoperative wound healing was evaluated using Landry’s healing index
2	K.A.	2020	A split	N=2	Mean	Split	Intraoperative

	Ramkumar Ceyar et al		mouth randomised controlled clinical study	5	age of 25.6 yrs	mouth method; one side was assigned for knotless suture and contralateral side for conventional vicryl suture	wound closure time Post-operative pain was evaluated using VAS score Post-operative swelling measured using 5 soft tissue points Maximal mouth opening recorded by measuring interincisal distance
3.	E. Crosetti et al	2019	Randomised clinical study	N=40	21-78yrs	Study cohort group reconstructed using barbed sutures and control cohort group reconstructed using conventional vicryl sutures	Intraoperative wound closure time No. of sticthes Complication rate and wound dehiscence

Table 3
Data extraction table

S.No	Author and year	echnique used	hod of ıation	ı values	omes
	A.K.Sharma et al 2020	One group receiving knotless barbed sutures and another group receiving conventional vicryl sutures	Intrao perativ e wound closure time Postop erative wound healing was evaluat ed using Landry 's healing index	Intraoperative wound re time Barbed sutures: 9.460 Vicryl sutures: 05 mins Post operative wound ng: Barbed sutures: POD 1st– 2.75 POD 3rd – 3.40 POD 7th – 4.05 Vicryl sutures: POD 1st– 2.0 POD 3rd – 2.70 POD 7th – 3.65	operative woun d closure time was significantly reduced knotless ed Sutures perative Wound ng Was rved To be r with no ence of wound dehiscence Knotless barbed res group.
	K.A. Ramkumar Ceyar et al 2020	Split mouth method; one side was assigned for knotless suture and contralateral side for conventional vicryl suture	Intrao perativ e wound closure time Post-operati ve pain was evaluat ed	Intraoperative wound re time Barbed sutures: 2.45 Vicryl sutures: 30 mins Pain (VAS Score) *Barbed sutures:* POD 1st– 5.56 POD 3rd – 3.08	operative woun d closure time was significantly reduced knotless ed Sutures The ence in mouth

			using VAS score Post-operative swelling measured using 5 soft tissue points Maximal mouth opening recorded by measuring interincisal distance	POD 7th – 0.44 Vicryl sutures: POD 1st– 8.44 POD 3rd – 5.76 POD 7th – 2.19 Swelling: (mm) Barbed sutures: Post-op: 35.14 POD 1st– 41.69 POD 7th – 36.1 Vicryl sutures: (mm) Post op: 36.16 POD 1st– 48.06 POD 7th – 41.26 Maximal mouth opening(mm): Barbed sutures: Pre-op: 39.4 POD 1st– 33.02 POD 3rd – 35.22 POD 7th – 39.4 Vicryl sutures: (mm) Pre-op: 38.84 POD 1st– 28.27 POD 3rd – 30.56 POD 7th – 35.64	h opening, VAS score, and ing were statist stically Significant On 1st in Barbed re Group and Vicryl group Indicating Reduction in Pain, ing And ovement in outh opening On 7th POD Barbed re Group pared To vicryl re group. None of the nts Exhibited plications; No incidence Of wound dehiscence ovement Woun ound healing was mented.
	E. Crosetti et al 2019	Study cohort group	Intraoperative	Intraoperative nd closure time	o operative woun

		reconstructed using barbed sutures and control cohort group reconstructed using conventional vicryl sutures	wound closure time No. of stitches Complication rate	Barbed sutures: 486 Vicryl sutures: 75 mins No. of stitches: ian) Barbed sutures: 3.35 Vicryl sutures: 15.95 Complication rate Barbed sutures: 15% Vicryl sutures: 30%	d closure time was significantly reduced knotless ed Sutures Lower ber Of stitches Used in ed Suture p Compared Vicryl re group. The overall Percentage Major and r blication rate Was lower decrea reduced ence Of wound Dehiscence Barbed re

Table 4
Evidence level of selected articles

SI No	Author and year	Study design	Level of Evidence
1.	A.K.Sharma et al 2020	Randomised controlled clinical study	1b
2.	K.A. Ramkumar Ceyar	A split mouth randomised	1b

	et al 2020	controlled clinical study	
3.	E. Crosetti et al 2019	Randomised clinical study	1b

Table 5
Risk of bias- major criteria

S.No	Study	Randomization	Allocation concealment	Assessor Blinded	Drop outs described	Risk of Bias
1	A.K.Sharma et al 2020	Yes	Yes	No	None	Moderate
2	K.A. Ramkumar Ceyar et al 2020	No	No	No	Yes	Moderate
3	E. Crosetti et al 2019	No	No	No	None	High

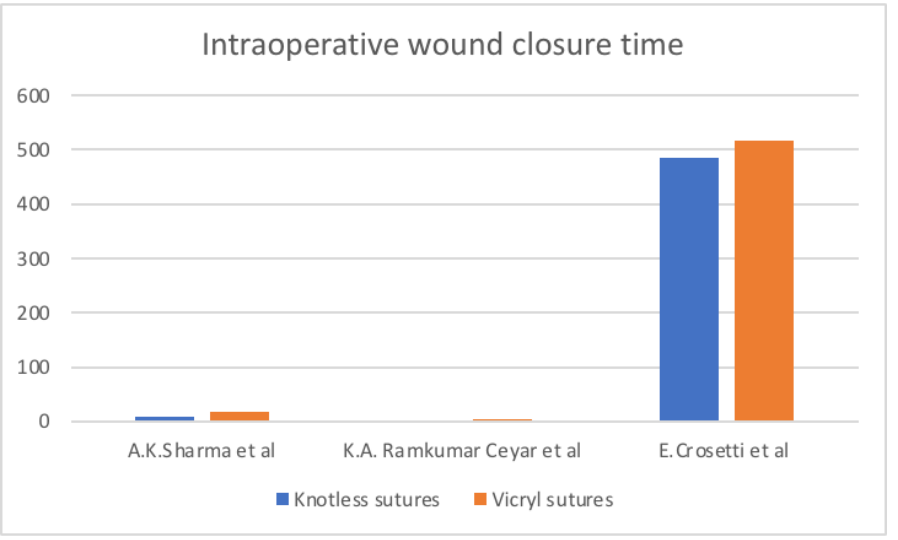
Table 6
Risk of bias-minor criteria

S.No	STUDY	SAMPLE JUSTIFIED	BASELINE COMPARISON	I/E CRITERIA	METHOD OF ERROR
1	A.K.Sharma et al 2020	Yes	Yes	Yes	No
2	K.A. Ramkumar Ceyar et al 2020	Yes	Yes	Yes	No
3.	E. Crosetti	No	Yes	Yes	No

	et al 2019				

Table 7
Summation table for individual parameter

S.No	Author	Year	E Evaluation period	Outcome
1	A.K.Sharma et al	2020	Intraoperative Wound closure time	There is a significant difference between two groups, result results are in favour of Barbed sutures group
2	K.A. Ramkumar Ceyar et al	2020	Intraoperative Wound closure time	There There is a significant difference between two groups, result results are in favour of Barbed sutures group
3.	3E. C E. Crosetti et al	2019	Intraoperative Wound closure time	There There is a significant difference between two groups, result results are in favour of Barbed sutures group



Graph 1. represents the Intraoperative wound closure time where X-Axis represents groups (Knotless suture group and Vicryl suture group) and Y-Axis represents the intraoperative wound closure time. This graph represents that there is a significant reduction in intraoperative wound closure time in Knotless suture group compared to conventional vicryl suture group

Discussion

Intra oral suturing is technically challenging because of constricted space available for instrumentation and placement of knots. Overtightening of knots to prevent probability of knot slippage impairs fibroblast proliferation and compromises wound closure thereby necessitating a knot holding instrument or assistant along with knot related tissue irritation. (4) . Also, wound healing following intra oral suturing may be compromised due to the tendency of the knots which act as a nidus to attract food debris and colonization of microbial flora which are inherent to the oral cavity. (8) . Further, intraoral suturing may be challenging due to the dynamic anatomic structures that stretch the wound margins during vital functions like mastication, speech and swallowing.(2,17)

Intraoral suturing in maxillofacial surgery should be aimed at the following; readaptation and maintenance of surgical flaps in normal anatomic position to facilitate wound healing (2,18),(4) ; providing water-tight closure to avoid contamination of surgical site by saliva and food debris(4) ; prevention of implant or graft exposure; providing adequate strength against the dynamic peri-oral musculature. Improper suturing can result in wound dehiscence, tissue ischemia, local infection (19), hardware exposure and delayed wound healing(2,17). A good suture material can negate these complications. (16)

Currently, the options for intraoral wound closure are numerous, which vary in structure and composition and are currently being used which require placement of knots to secure the suture material and range from resorbable and non-resorbable suture materials to non-suture materials such as cyanoacrylate, fibrin

glue and adhesive tapes. The choice of suturing method and suture material also depends on the anatomical site, type of wound and nature of the tissues handled. (4) . Fibrin glue and cyanoacrylates are alternatives to suture less wound closure, but associated with limitations such as technique sensitivity, inability to provide adequate initial strength to the approximated wound (4) and are not ideally suited for regions constantly subjected to constant muscular forces. Also, fibrin glue requires a preparatory phase and cannot be stored for a long time after reconstitution, with associated risks of hypersensitivity and transmission of blood borne diseases. Cyanoacrylates cannot be used in infections and demonstrate desquamation on mucosal application. (20)

John H.Alcamo was issued US Patent in 1964 for the design of the barbed sutures. (21). The use of barbed sutures was first reported by Mc Kenzie in human cadaveric models and animal studies. (22). After FDA approval in 2004, barbed sutures have been extensively in various surgical procedures. (1,23). The knotless barbed suture device consists of tiny barbs along its entire surface, arising from opposite directions on either side of a central non-barbed segment. The peripheral barbed segments are called the arms, while the central non-barbed segment is termed the transition point. This facilitates engagement into the tissues during suturing. The wound margins thus approximated, do not require knots to secure the sutures. The insertion of sutures is facilitated by needles swaged on either side of the suture. (4). Unidirectional barbed sutures consist of a single swaged needle and barbs pointing along a single direction while bidirectional barbed sutures demonstrate needles on either end with the orientation of barbs getting reversed in the centre of the suture. (24).

The suture is available as resorbable (PDS or PGA-PLA) and non-resorbable (nylon or polypropylene) mono filamentous forms in variable sizes (5-0 to 2-0) and lengths (3.5 X 3.5 cm to 45 X 45cm) which may be dyed or non-dyed. The effective core diameter of a barbed suture is less as compared to a similar sized Vicryl suture due to the barbs cut across the longitudinal axis of the suture material. (23,25) However, a size 0 barbed suture equals a 2-0 smooth suture in tensile strength because the process of knotting results in structural deformation of smooth suture material which eventually reduces its tensile strength (23,25) by 35-95%. Thus, even though the diameter is smaller, the tensile strength and mechanical integrity of a barbed suture is much more efficient than similar sized polyglactin 910 suture.(4) Further, studies have established that the knot and the adjoining suture constitute the weakest part of any suture. (21)

The scope for intraoral use of knotless suture is tremendous.The first use of knotless sutures for intraoral wound closure was reported by Ganesh SK(1) et al in ORIF of Le Fort fracture where knotless sutures simplified the suturing technique as well as negated the accumulation of debris at surgical suture site. Knotless sutures provide the best wound approximation with simple continuous suturing technique. This is mainly because the retention capacity of the sutures, in the absence of knots, is directly proportional to the number of barbs engaging into the tissues. The barbs anchor deeply into the tissue and provide better eversion of tissue which favours ideal wound healing. (25)

They reduce the suturing time by eliminating the requirement of a knot to provide secure closure. Suturing with knotless sutures is less technique sensitive resulting in ease of suturing and the time taken to adapt to this new material is also negligible even in the hands of a trainee surgeon. (8) They eliminate the nidus of infection (knots) resulting in negligible entrapment of food debris or surrounding tissue reaction which eliminates inflammatory mediators and microbial colonization. Furthermore, a watertight wound closure provided by these sutures prevents any seepage of fluids into the wound. These factors may be responsible for the reduced post-operative pain or infection which eventually contributed to better wound healing. (26,27). In all three of the studies, they have concluded that there was a significant reduction in intraoperative wound closure time and improvement in wound healing following use of knotless barbed sutures as an intraoral wound closure agent in maxillofacial surgery procedures.
There are some limitations to this study, which includes that all patients in the studies were treated surgically in one institution. Also, further blinded clinical trials with a larger sample size and longer follow up need to be conducted to add more clinical data regarding delayed tissue reaction and for widespread applications in maxillofacial surgery.

Interpretation of Results

In a study conducted by A.K.Sharma et al in 2020, a total sample size of 40 patients undergoing ORIF was taken with each group consisting 20 patients. In one group, wound closure was done using bidirectional knotless barbed sutures and in the other group wound closure was done using resorbable vicryl sutures. Intraoperative wound closure time was significantly reduced with knotless barbed suture group. The wound closure time was 9.460 mins in the barbed suture group and 17.605 mins in the control group. Also, the postoperative wound healing was observed to be better with no incidence of wound dehiscence in barbed suture group.

In a study conducted by K.A.Ramkumar Ceyar et al in 2020, a total sample size of 25 patients undergoing bilateral mandibular third molar impaction of similar difficulty index was taken. One side wound closure was done using knotless barbed suture and on the other side wound closure was done using resorbable vicryl sutures. Intraoperative wound closure time was significantly reduced with knotless barbed suture group. The wound closure time was 2.45 mins in the barbed suture group and 4.1480 mins in the control group. Also, The difference in mouth mouth opening, VAS score, and swelling were statistically significant on 1st POD in barbed suture group indicating reduction in pain, swelling, and improvement in mouth opening on the 7th POD in the barbed suture group compared to the control group which facilitated effective wound closure.

In a study conducted by E.Crosetti et al in 2019, a total sample size of 40 patients undergoing reconstruction following squamous cell carcinoma of tongue was taken with each group consisting 20 patients. In one group, wound closure was done using knotless barbed sutures and in the other group wound closure was done using resorbable vicryl sutures. Intraoperative wound closure time was significantly reduced with knotless barbed suture group. The wound closure time

was 486 mins in the barbed suture group and 516.75 mins in the control group. Also, a lower number of stitches were used in the barbed suture group along with a reduced incidence of complication rate and wound dehiscence.

Summary

The aim of this systematic review is to assess the effectiveness of knotless barbed sutures as an intraoral wound closure agent in Oral and Maxillofacial Surgery. There were 3 randomised controlled trials included in this systematic review and all three of the studies have evaluated the intraoperative wound closure time which was found to be significantly reduced. In these studies only a small number of patients were evaluated. The improvement in wound healing was also not documented in all of the studies. Hence, more studies with a larger sample size and longer follow up are to be done in future. Thus in this systematic review, we conclude that knotless sutures are an effective option for intraoral wound closure in maxillofacial surgery procedures.

Conclusion

In this systematic review we conclude that knotless barbed sutures reduces the intraoperative wound closure time, which simplifies suturing technique and facilitates superior wound healing thereby proving to be effective as an intraoral wound closure agent in maxillofacial surgery procedures. However, further blinded clinical trials with a larger sample size and longer follow up need to be conducted to add more clinical data regarding delayed wound healing and widespread application of these sutures in maxillofacial surgery procedures.

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