

# Herbal remedies for mandibular fracture healing

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## ABSTRACT

**Purpose:** When a bone is fractured it is usually necessary to employ a mechanical means to reduce and maintain the fragments in position. However, healing of the fracture is governed by biological principles, with which the mechanical measures must be coordinated to the end, such that a satisfactory bony union and restoration of form and function are obtained. We have studied the effect of *Cissus quadrangularis* (*Harjor*) and *Ocimum sanctum* (*Tulsi*), in the healing of mandibular fractures. **Materials and Methods:** A total of 29 cases having a fracture in the body of the mandible were included in the study and divided into three groups. Groups A and B were treated with *Ocimum sanctum* and *Cissus quadrangularis*, respectively, and fracture healing was assessed with biochemical markers and the bite force. Group C was the control group. **Results:** The period of immobilization was the lowest in the Group A followed by Group B. A significant increase in alkaline phosphatase and serum calcium was seen in Group B. The tensile strength in terms of the biting force was the maximum in cases of Group B. **Conclusion:** We conclude that *Cissus quadrangularis* and *Ocimum sanctum* help in fracture healing, and use of such traditional drugs will be a breakthrough in the management and early mobilization of facial fractures.

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## INTRODUCTION

Fracture of the jaw bones not only render physical trauma, but also make the person miss out on work productivity and other social obligations for a period ranging from four to eight weeks, on an average. The modern system of medicine has been directing itself to find ways and means of reducing the healing period. These attempts have by and large met with indifferent success, except maybe in stable internal fixation where it is claimed that the bone heals faster (through osteonal healing) and the patient is restored back to normal function almost immediately.

During the past decade or so surgeons have laid a greater stress on various mechanical devices that could be

quickly applied either by the close or open method. This emphasis on mechanical fixation has become so great in the recent years that many workers started presuming that the bone was an inert substance needing only a means of immobilization for healing.

Fracture healing involves complex processes of cell and tissue proliferation and differentiation. Many factors are involved, including growth factors, inflammatory cytokines, antioxidants, bone breakdown (osteoclast), bone-building cells (osteoblasts), hormones, amino acids, and uncounted nutrients.

Phemister described that biological and mechanical principles must be coordinated for healing of fractures.<sup>[1]</sup> The Ayurvedic system of medicine has a knowledge of many herbal preparations that are known to hasten bone healing. Such agents have been described as vitalizers, better known today as adaptogens.

This study has been undertaken with the intention of studying the adaptogens *Ocimum sanctum* (*Tulsi*) and *Cissus quadrangularis* (*Harjor*), and their role in the healing of mandibular fractures.

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Singh *et al.*, studied the anti-stress activity of the indigenous drug *Ocimum sanctum* (Tulsi) and found it to be very useful in viral-encephalitis (Japanese type B).<sup>[2]</sup> A clinical trial of *Ocimum sanctum* (Tulsi) extract in stress-related hypertensive patients was found to be effective in reducing and maintaining the blood pressure in these patients.<sup>[2]</sup>

*Cissus quadrangularis* (Harjor) has been known for its bone healing properties for many centuries. It has been prescribed by the bone setters in a crude form both for external use, as a paste over the fractured limb, and internal use, as a decoction. Many workers have studied the bone healing property of *Cissus quadrangularis*.<sup>[3-6]</sup> Udupa found the beneficial effects of this drug in fracture healing, in rats, dogs, and even in human beings, and revealed that *Cissus quadrangularis* hastens fracture healing by reducing the convalescent period by 33%, as seen in experimental animals.<sup>[7]</sup>

Chopra *et al.*, used the extract of *Cissus quadrangularis* in dogs and found a marked difference of progress in the endochondral ossification in the treated cases, as compared to the untreated ones. In untreated cases the callus was predominantly of cartilage, whereas, in the treated cases condensed bony trabeculae were present.<sup>[8]</sup>

*Ocimum sanctum* (Tulsi) is considered the best adaptogen, as it brings the pathological process occurring in the body to a normal physiological process. Homeostasis is the main requisite for normal physiology. Stress of any type may disturb this homeostasis and can lead to a pathological process. The substance that can reverse the stressful situation is known as an adaptogen. An adaptogen affects the nutritional values in the plasma, vitalizes digestion and metabolism, and improves microcirculation.<sup>[9]</sup>

## MATERIALS AND METHODS

A total of 29 cases having a fracture of the mandible were included in the study and divided into three groups. Grouping was made on the basis of the coded drugs that these patients received.

Group A - *Ocimum sanctum* (Tulsi) one teaspoonful (tsf) QID (2.5 g six hourly).

Group B- *Cissus quadrangularis* 1 tsf TDS (3.5 g eight hourly).

Group C - Placebo 1 tsf TDS.

These drugs comprised of a powder of Tulsi leaves (*Ocimum sanctum*) and Harjor (*Cissus quadrangularis*) 80% alcoholic extract, whereas, the placebo was starch powder. These

drugs were supplied by the National Botanical Research Institute; Lucknow.

The history of every patient was recorded on a set proforma. The patients were diagnosed on the basis of clinical examination and radiographic interpretation. Before administration of the drug, thorough clinical, radiological, biochemical, and hematological profiles were carried out. Subsequent investigations were carried out during the period of fracture healing till mobility at the fracture site became zero. Mobility and biting force at the fracture site were recorded before treatment and at weekly intervals after the therapy with the drug under trial, till clinical union of the fracture.

Bite force measurements were made using the indigenous Bite Force Recorder, designed at the Research Designs and Standard Organization (RDSO), Lucknow. The recorder consisted of four strain gauges mounted on steel bars, forming a wheat stone bridge based on the principle of Ellis and Throckmorton. Load changes in the steel bar produced a measurable voltage change across the four strain gauges, which were converted into kilogram force (kp).

## OBSERVATION AND RESULT

A total of 29 patients were included in the study, in the 20-40-year age group, out of which two were female and 27 were male. The most common site of fracture was the angle of the mandible followed by the canine region.

The healing period was assessed by the time of immobilization. A significant reduction in the time of immobilization was found in both Groups A and B. It was  $4.25 \pm 0.11$  weeks in group A (*Ocimum sanctum*),  $5.0 \pm 0.15$  weeks in group B (*Cissus quadrangularis*), as compared to  $6.25 \pm 0.08$  weeks in group C (Placebo) [Table 1].

There were significant changes in hematological and biochemical parameters in group B treated with *Cissus quadrangularis*. There was a significant change in the hemoglobin percentage from  $12.8 \pm 0.28$  to  $13.6 \pm 0.21$  g% ( $P < 0.05$ ), alkaline phosphatase from  $12.2 \pm 0.87$  to  $14.4 \pm 0.41$  KA unit/100 ml ( $P < 0.05$ ), serum calcium from  $9.5 \pm 0.41$  to  $11.5 \pm 0.42$  mg% ( $P < 0.01$ ), blood sugar from  $123.56 \pm 1.31$  to  $113.4 \pm 1.0$  mg% ( $P < 0.001$ ), and blood urea from  $23.1 \pm 1.98$  to  $28.9 \pm 1.48$  mg% ( $P < 0.05$ ), as compared to the control group [Table 2].

**Table 1: Mean period of clinical healing in groups**

Group	Mean period (in weeks)	t value	P value
Control	$6.25 \pm 0.08$	-	-
<i>Ocimum sanctum</i>	$4.25 \pm 0.11$	4.6	<0.001
<i>Cissus quadrangularis</i>	$5.00 \pm 0.15$	2.6	<0.05

**Table 2: Pre- and post-treatment hematological and biochemical values**

	Control		<i>Ocimum sanctum</i>		<i>Cissus quadrangularis</i>	
	Pre treatment	Post treatment	Pre treatment	Post treatment	Pre treatment	Post treatment
Hemoglobin (g%)	13.2 ± 0.32	13.26 ± 0.32	12.6 ± 0.34	13.26 ± 0.34	12.8 ± 0.28	13.6 ± 0.21
Serum calcium (mg%)	10.4 ± 0.65	11 ± 0.56	10.5 ± 0.29	11.3 ± 0.35	9.5 ± 0.41	11.5 ± 0.42
Serum phosphate (mg%)	3.36 ± 0.17	3.08 ± 0.19	3.167 ± 0.29	2.75 ± 0.34	3.14 ± 0.30	2.8 ± 0.26
Alkaline phosphatase KA unit/100 ml	11.2 ± 0.30	11.3 ± 0.4	11.2 ± 0.33	11.8 ± 0.28	12.2 ± 0.87	14.4 ± 0.41
Blood sugar	111.9 ± 2.4	115.4 ± 1.24	111.7 ± 2.6	115.4 ± 1.69	123.56 ± 1.31	113.4 ± 1.0
Blood urea (mg%)	21.3 ± 1.8	22.2 ± 1.27	19.95 ± 1.85	20.3 ± 1.75	23.1 ± 1.98	28.9 ± 1.48

The biting force recorded was identical in all three groups at the time of the clinical union of fractures. The tensile strength in terms of the biting force was found to be maximum in the cases treated with *Cissus quadrangularis* ( $P < 0.001$ ). The radiographs showed good radiological evidence of healing at the fracture site in the *Cissus* group (group B), followed by the *Ocimum* group (group A), and the control group (group C) [Table 3].

## DISCUSSION

The prolonged period that is required for healing of a fracture is a source of much distress both to the surgeon and the patient. The patient has to wait for weeks, months, and even years before they can use their fractured jaw properly. This entails much suffering and economic loss to the patient. Therefore, it has all along been the endeavor of scientists to find certain agents that may hasten healing, and thereby, cut short the duration of convalescence. The present study has been undertaken to evaluate the osteogenic activity of certain indigenous drugs like *Ocimum sanctum* and *Cissus quadrangularis* in the clinical situations using glucose as the control.

The present study indicates that there was significant reduction in the required period of immobilization in group A, followed by group B, as compared to group C. In contrast to the reports of Udupa and Prasad,<sup>[10]</sup> who reported that their experience with oral administration with this drug was not very encouraging, our result very clearly shows the effectiveness of *Cissus quadrangularis* after oral administration.

Udupa and Prasad found that the bones surrounded by a lesser muscle mass showed a poor result on the topical application of *Cissus quadrangularis*, as compared to the bone surrounded by a thick muscle mass.<sup>[10]</sup> However, in our study, cases of a fractured mandible, which is surrounded by a poor muscle mass shows good result.

Although there was a rise of blood urea from 23.1 to 28.9 mg% after treatment with *Cissus quadrangularis*, this was within the normal range (15-40 mg%). It would be desirable to use a lower dose in subsequent studies, to be on the safe side. Our study shows that *Cissus quadrangularis* possesses hematinic and hypoglycemic

activities as well, which substantiates the study by Nadkarni<sup>[11]</sup> and Chopra.<sup>[12]</sup>

Bone is a living tissue, which remains in a state of dynamic equilibrium with the body fluid and it is a very plastic tissue responsive to a great variety of stimuli, such as, hormonal, nutritional, mechanical, vascular, biochemical, genetic, and pathological stimuli, which may disturb the cellular balance. This can be corrected by adaptogenic drugs.<sup>[2]</sup> Among the adaptogenic drugs, the best one is *Ocimum sanctum*, used in the present study. It is likely that this drug acts by normalizing such a disturbed balance by acting on the calcium uptake mechanism or some other enzymatic mechanism involved in the calcification and remodeling of bone, such as, alkaline phosphatase, succinic dehydrogenase, prostaglandins, c-AMP, GMP, and so on.<sup>[2]</sup>

In our study the tensile strength measured in terms of biting force was the maximum in the *Cissus* group. Udupa and Prasad also reported similar results where tensile strength was gained earlier in the *Cissus* group, as compared to the control.<sup>[7]</sup>

The ethanol extract (95%) of *Cissus quadrangularis* enhances the development of cortical bone and trabeculae in the fetal femur, which may be related to the rich content of calcium, phosphorous, and phytoestrogenic steroids, and it is shown to influence early regeneration and quick mineralization of the bone fracture healing process.<sup>[3]</sup> The petroleum ether extract of *Cissus quadrangularis* can stimulate the differentiation of mesenchymal stem cells into osteoblasts in a dose-dependent manner, even in the absence of the osteogenic conditioning media.<sup>[6]</sup>

A study by Singh *et al.*, showed that osteopontin expression by the flow cytometric and Western blot analyses had a significant percent of CD4+ T cells expressing osteopontin in the blood samples of patients of the group treated with *Cissus*, when compared with the control group, and they concluded that there was better healing of fractures in the group treated with *Cissus*.<sup>[13]</sup>

## CONCLUSION

In the present study, the period of immobilization was

**Table 3: Values of biting force in kilograms recorded pre and post treatment with drugs**

Group	Mean ± SE pre-treatment	Mean ± SE post-treatment	t value	P value
Control	1.04 ± 0.04	2.12 ± 0.05	16.8	<0.001
<i>Ocimum sanctum</i>	1.00 ± 0.06	1.62 ± 0.25	2.48	<0.05
<i>Cissus quadrangularis</i>	0.96 ± 0.03	2.23 ± 0.05	21.8	<0.001

the lowest in the *Ocimum sanctum* group followed by the *Cissus quadrangularis* group. The tensile strength measured in terms of biting force was maximum in the *Cissus quadrangularis* group. Thus, we conclude that the use of such traditional drugs will not only be a breakthrough in the management and early mobilization of facial fractures, but will also prove to be a boon to the present day life of industrialization, where many more cases of traumatic injuries are bound to occur.

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